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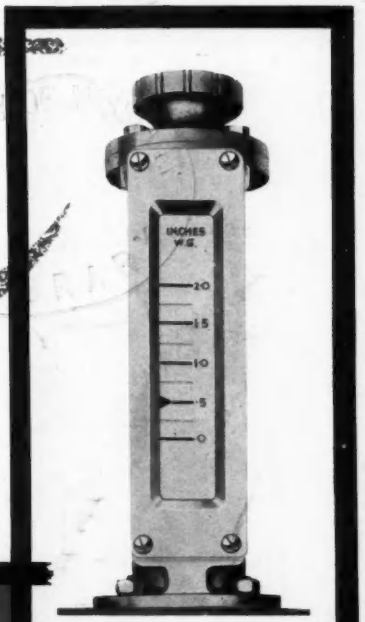

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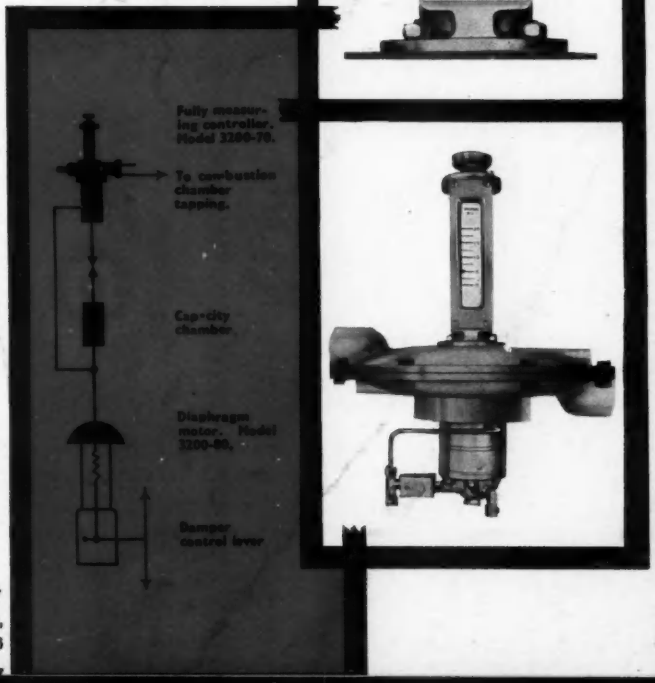

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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

JUNE 1961

VOLUME 76. No. 6

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The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

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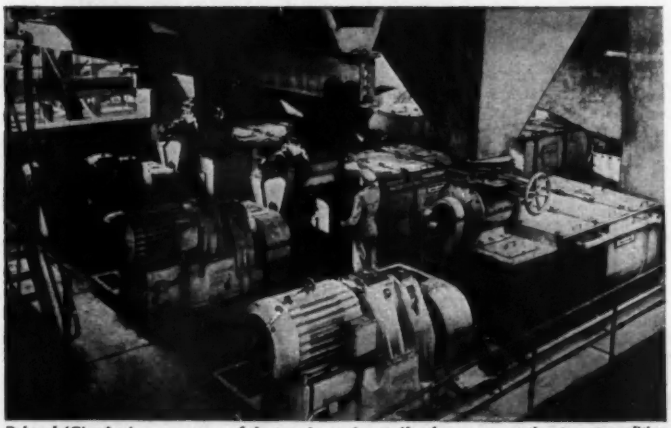

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JUNE 1961
VOLUME 76 No. 6

ARE SOME STANDARDS UNNECESSARILY HIGH ?

AT the seventh Standards Engineers' Conference, organised by the British Standards Institution and the Institution of Production Engineers, held in London on May 9th/10th, and attended by some 230 engineers and others concerned with the application of standards, the view was expressed by one of the speakers that some British standards were, perhaps, unnecessarily severe in the level of performance required of them. This particular speaker (Mr. I. McLaine, of Hawker Siddeley Industries Limited) instanced in particular such standards as those for transformers, flame-proof enclosures and tower-cranes in which he thought the safety margin was often fixed at a point unrealistically high. He was talking on " Standards and Market Research " and he made the novel suggestion that the British Standards Institution could, perhaps, give a lead in this field by setting up a market research advisory committee to see whether market research could not in some way be utilised in preparing standards.

The conference was opened by Viscount Hailsham, Lord President of the Council and Minister for Science, who told delegates " An efficient economy requires standards—partly in order to achieve savings by the elimination of unnecessary variety and partly in order to reduce waste and danger by preventing the production of sub-standard goods." Opinions might differ as to how far, and in what manner, national standards are to be compulsory, he went on. " Whatever view we take on this, it is clear that they cannot simply be imposed from without, whether by Government or by any other external force. They must result from discussion between representatives of the producer and the user ; they must be a blend of scientific knowledge and industrial and commercial experience; and they must be expressed clearly and intelligibly.

Stressing the need to revise existing standards, as well as to produce new ones, Lord Hailsham said " Old standards which had become obsolete are, or can be, as dangerous to industry as no standards at all. It is essential that our standards should be a real incentive to adopt what is best in current engineering practice and not a means of tolerating the mediocre or worse than mediocre.

Mr. D. F. Egan (Mullard Limited), who presented a paper on standards in production development, with reference to the electronics industry, pointed out that the special characteristics of the electronics industry, particularly its rate of growth, did not appear to be conducive to the introduction of a standards programme. Nevertheless, there were factors common to many generations of the product which could usefully be subjected to the standardising process. Mr. Egan instanced the standards of geometry and dimensions which had been developed for the bases and terminal caps of electronic valves and tubes. The highest production quantities and the correspondingly cheapest articles were covered by a very small number of the available standard types—probably no more than four or five bases and two or three caps, said Mr. Egan. " The whole industry has, without doubt, derived benefits from this restriction. These benefits include the ready acceptance of other evolutions and improvements in the product, such as variants of a basic type with better electrical performance, and the economies due to rationalisation of component parts and similar rationalisation in the types and numbers of production machines which are required for them." Mr. Egan also discussed means of describing the quality and performance of semi-conductor devices such as transistors—a field in which B.S.I. was doing some of its most fruitful work, he said. Recommended methods of carrying out measurements both of working conditions and of characteristics of semi-conductor devices were now being evolved.

Mr. F. B. Butcher (Joseph Lucas Limited), in his paper on " An Integrated Standards Programme in the Company," said we must be certain that the cheaper product does not result in higher operating costs. For example, a reduction in the number of electrical motors in a range could possibly result in a reduction in manufacturing costs, but it might be worth investigating the cost to the nation of the power consumed during the life of these motors to see if an increase, instead of a reduction, in the number of machines in the range would result in an overall saving. It seems that at present we have no body, or authority, checking these things, and the B.S.I., given the necessary help, could play a more active part in cases where the need extends the field usually considered. " Technical economics should play a larger part in standards programmes, and economists can provide considerable help in this field. We are all inclined to consider standardisation only so far as we see it and sometimes our vision is very limited."

Three suggestions regarding British standards were made by Sir Stanley Harley when he summed up the first day's proceedings. First, he proposed that B.S.I. technical committees could give more thought to differentiating between first, second and third preferences in British standards. Next, he suggested that thought could be given to including in the appendices of British Standards, guidance for designers on what were believed to be the future trends for the product concerned. Such guidance could always be kept under review. Finally, Sir Harley suggested that industry must ask whether its standards were too conservative compared with international practice, to which we must increasingly look if our export trade was to prosper. From these and other points of view, market research should be brought into B.S.I.'s deliberations on standards.

On the second day of the conference, a series of six separate sessions was held at British Standards House. Delegates split into groups to discuss various topics, a speaker initiating each group's discussions.

Points and Pointers

INCREASED DEMAND FOR N.I.F.E.S. SERVICES

During the first quarter of 1961, the demand for advice from the National Industrial Fuel Efficiency Service is stated to have reached the highest level ever. The value of orders placed with N.I.F.E.S. during the financial year 1960/61 was stated to be 21 per cent. higher than in the previous year. The number of detailed surveys completed in works, factories, and commercial premises generally, has now passed the 3,250 mark. These surveys are being devoted more and more to improving the heat-using processes in the factories as well as improving the efficiency of boiler plants. Fuel savings (which on average amount to 20 per cent.) have, in many instances, also been accompanied by increased output from the plants, and by better quality products. More than 900 of N.I.F.E.S. clients now have regular service agreements whereby their premises are regularly visited by N.I.F.E.S. engineers who assist the firms to maintain their boiler plant, process plants and heating plants at the highest possible level of efficiency. Another interesting programme of refresher and training courses, etc., has been arranged by N.I.F.E.S. The sixth annual refresher course for works and plant engineers will be held at the Clarendon Laboratory, Oxford (residence at Brasenose College) from September 25th to 29th, 1961. Courses on the latest developments in solid-fuel-firing equipment are now being held regularly in Manchester, the dates of forthcoming courses this year being July 17th to 21st, and September 11th to 15th. Courses on the use and maintenance of oil-firing equipment are held regularly at N.I.F.E.S., Reading office, dates of forthcoming courses this year being September 19th to 21st, November 14th to 16th, and December 12th to 14th. Further information regarding these courses can be obtained from N.I.F.E.S. at 71, Grosvenor Street, W.1.

ELECTRICAL RESEARCH ASSOCIATION

The fortieth anniversary of the Electrical Research Association provides a convenient viewpoint for looking at the origins and development of the Association as an organisation for co-operative research. Incorporated on September 22nd, 1920, the E.R.A. was the tenth association to be set up under the aegis of the Department of Scientific and Industrial Research—a department which itself was established in 1916, when the exigencies of the First World War were disclosing some of the serious deficiencies of industrial research in Great Britain. The E.R.A. was founded jointly by the Institution of Electrical Engineers, the British Electrical and Allied Manufacturers' Association and the D.S.I.R., and nominations to its council were made by each of these bodies. For a few years, the E.R.A. had no laboratories of its own and its activities took the form of sponsored work at the National Physical Laboratories and at various universities. In scope, its researches were mainly concerned with fibrous insulants, synthetic resins, composite insulating materials, porcelain, mica insulating materials, and turbine blading materials. Research was also done on specific products such as cables and nozzles, and on corrosion phenomena. The E.R.A. has produced more than 2,000 reports which have been issued to all members who are interested. Researches have taken many different forms—some very practical, others fundamental. Often, the results have been quickly appreciated and applied, but in others, the E.R.A. has merely been playing its part in the general contribution towards elucidation of fundamental behaviour of materials and apparatus. Very few branches of the electrical industry have been uninfluenced by its work. Whilst a great deal of research has been done, the Association has also played a significant part in the accumulation of data for the preparation and revision of standard specifications, a task which it took over from the I.E.E. in the early days. The Association has since acted as co-ordinator of data for the makers and users of insulating materials for the electrical industry leavening the whole with scientific advice from the staff and occasional research. In the early days there were eleven sectional committees and thirty-one research committees. By 1960 there were twenty-two sectional committees and no less than eighty-one research committees. Since January 1st, 1961, the structure has been "streamlined" so that the work of the Association will in future be superintended by six divisional committees. Better control and co-ordination of staff are among the main benefits to be expected from these changes. The philosophy underlying these developments was revealed in some of the remarks made by Mr. O. W. Humphreys, chairman of the Council of E.R.A., at the Association's annual luncheon held last month.

NEW BEAMA SECTIONS

An indication of the way in which the BEAMA is adapting its organisation to developments within the electrical industry, is given by the announcement of the establishment of two new sections—the Industrial Electronic Equipment Section and the Nuclear Reactor Section. In addition to the day-to-day work relating to technical matters, standardisation, exports and statistics, the Industrial Electronic Equipment Section will also provide a means of closer discussions with other associations, and help towards the wider examination of general policy questions affecting the industrial electronics industry as a whole. Mr. W. Gregson, of Ferranti Limited, has been elected chairman, while Mr. R. J. F. Howard, of Metal Industries Limited, has been appointed vice-chairman, and Mr. A. Newton, secretary. The Nuclear Reactor Section will cover nuclear reactors for electrical power applications. Membership of the section will be open to all those members of the BEAMA who, as participants in groups or consortia concerned with the design and building of nuclear reactors for electrical power applications, undertake contractual responsibility for the operation of these reactors. The present members are Associated Electrical Industries

Limited, The English Electric Co. Ltd., The General Electric Co. Ltd., C. A. Parsons & Co. Ltd., and Babcock & Wilcox Limited. The establishment of this section ensures that the interests of the BEAMA manufacturers over the whole field of plant and ancillary equipment for nuclear power generation are covered by appropriate sections of the Association. Mr. G. T. H. Spurling has been appointed secretary of the Nuclear Reactor Section.

PROGRESS ON A.G.R. AT WINDSCALE

The United Kingdom Atomic Energy Authority states that the construction of the prototype advanced gas-cooled reactor is now approaching its final stages at Windscale, in spite of labour troubles which have caused considerable delays. It is intended that construction will be completed in July and that the reactor will then be handed over to operation staff for fuel loading in the late autumn. Inside the reactor vessel, the graphite core and its supports are complete, and the neutron shield has been erected. The can-failure detection pipes are being fitted and connected to the precipitators which have already been installed. One gas-circulator has been successfully tested on a heat-exchanger at design conditions of temperature and pressure, and is now undergoing minor modifications. A second machine has been delivered, and continuous running tests are under way. The refuelling machine has been erected at the contractor's works and is undergoing tests before being dismantled for transport to the site and re-erection there. Outside the reactor containment building, construction is practically complete. Much of the turbine hall electrical plant is installed, the dump-condenser is finished, and erection of the turbine is well-advanced. Progress on the construction of "Hero," the zero energy assembly alongside A.G.R., has been similarly hampered by labour difficulties, and the handover is now also expected to be in the autumn of this year. While construction has been proceeding, a number of components, such as control-rod mechanisms, have been undergoing tests, and they have proved satisfactory. The production of uranium-oxide pellets for the fuel elements is progressing well; quantity production of components for the stainless-steel canned elements has started very satisfactorily, and the assembly plant is being commissioned. In spite of the difficulties experienced with beryllium production, and the corrosion problems which have arisen, a quantity of beryllium-canned fuel elements are being produced, and it is planned that up to 20 per cent. of the first charge will be beryllium-canned.

ORGANISATION OF SANDWICH COURSES

The National Advisory Council on Education for Industry and Commerce, whose chairman is Sir Harry Pilkington, announce that they have started an enquiry on the organisation of sandwich courses in technical colleges and other colleges of further education. A sub-committee under the chairmanship of Mr. E. L. Russell, Chief Education Officer for Birmingham, has been set up "to examine the organisation of sandwich courses with a view to using college staff, equipment and accommodation and industrial training facilities to the best advantage; and in particular to consider 'end-on' arrangements." The sub-committee are examining the various ways in which practical experience in industry is combined with academic study in technical college courses. These methods include the "end-on" system under which two quite separate groups of students follow the same course, but use the college alternately, one group being in college while the other is in industry. Any organisation or persons wishing to submit evidence to the sub-committee, should write to the Secretary, National Advisory Council on Education for Industry and Commerce, Ministry of Education, Curzon-street, London, W.1.

TESTING TECHNIQUES FOR BOILER FLUE CASES

Those concerned with the design and operation of water-tube boilers are all too familiar with the external fouling and corrosion resulting from certain active gaseous and particulate constituents of flue gases. From its inception, the Boiler Availability Committee (8, Waterloo Place, London, S.W.1) realised the need for establishing suitable techniques for the rapid assessment of potential difficulties from these causes with a given boiler, fuel or method of operation. While individual techniques have been described in various papers, and in the technical press, details of the relative value and limitations of each method are not widely known. To overcome this, the committee have now published Bulletin XI "Testing Techniques for Determining the Corrosive and Fouling Tendencies of Boiler Flue Gases"—which provides details of suitable methods in a concise form. To ensure that results are comparable, sufficient details are given to enable recommended techniques—some of which were originally developed by the committee—to be applied successfully without reference to other sources. Testing methods are divided into two main groups. First, there are techniques for investigating low-temperature corrosion and its causes (meters for measuring "acid dewpoint" temperature, corrosion probes, instruments for determining sulphur dioxide and sulphur trioxide, also "acid deposition" probes). The second group comprises techniques designed for the determination of the nature and extent of high-temperature fouling (probes for measuring the rates of deposition of various constituents of fuel ash). Most of the techniques described are intended for tests of short duration, being designed to yield results within the hour. Such tests are ideal for the detailed investigation of rapid changes in boiler conditions. They are thus better suited for the comparison of different methods of boiler operation, or of variations in fuel characteristics, than the precise prediction of the period of trouble-free service likely to be obtained from a given component. Some of the tests listed are suitable for use over longer periods. For example, a liquid-cooled corrosion probe is described which can operate without attention for a period of 100 hours or more. As might be expected from this committee, careful attention is paid throughout the bulletin to the safeguards essential to ensure the correct operation of instrumentation in a boiler house. Details are also given of methods for obtaining the highest possible accuracy in each test even under adverse conditions.

Industrial organisations are requested to note carefully that copies of the Bulletin may be obtained only from British manufacturers of water-tube boilers, by application to the nearest representative or agent, at home or overseas.

Test Equipment for Nuclear Power Station Plant

A number of special test rigs and associated equipment have been designed and installed at Whetstone and Rugby by the English Electric, Babcock and Wilcox, Taylor Woodrow atomic power group, to enable reactor fuel charge/discharge machinery, blowers, etc., for Hinkley Point, Sizewell and future nuclear power stations, to be tested, as far as possible, under operating conditions before delivery to site. These test rigs described and illustrated in the following notes include a 90-ft. deep test pit in a building with 50-ft. headroom for the reactor charge machinery, and an almost similar shaft 70-ft. deep for testing the charge-hole preparation machinery, and the ancillary equipment associated therewith.

The importance of the operational reliability at site of the major assemblies of the equipment concerned, is emphasised by the fact that a high load factor and high availability are necessary to achieve low generating costs from nuclear power stations. Accordingly, this Group of companies has spent many hundreds of thousands of pounds on the establishment of this special testing plant whereby the reliability of vital machinery can be proved under simulated operating conditions before going into service.

During a recent visit to the Group's Whetstone and Rugby Works, we saw some of this impressive testing plant in operation. At Whetstone, the rig for testing the reactor charge/discharge machinery operates under gas temperature, pressure and flow conditions simulating closely those to be met under site conditions, but, of course, no provision can be made in such a rig to reproduce the effects of nuclear irradiation. This test rig comprises a pressure-vessel containing a simulated group of thirty-six fuel channels through which carbon-dioxide is pumped at the full working temperature and pressure of 400 deg. C., and 200 lb./sq. in. g. respectively. The complete charge/discharge machine, without its shielding can be lifted by a crane and located over the pressure-vessel stand-pipe. There, the full refuelling cycle can be followed and the operation of the charge machine and the charge chute thoroughly tested under working conditions; the force imposed by flow conditions on the fuel elements and the grab-head can thus be studied. To enable the machine to be tested as a complete unit, tests on control-gear are included. The pit also contains a shorter test installation representing the upper-section of the reactor to charge-pan level with thirty-six short fuel channels, each one fuel element deep. It operates under reactor conditions of temperature and pressure, but without the force due to gas-flow. Here, tests can be carried out on the charge chute and charge machine and the testing facilities of the unit increased. Rigs have also been set up to test the charge chute assembly for precision of operation out of reactor conditions and the function of the control-rods.

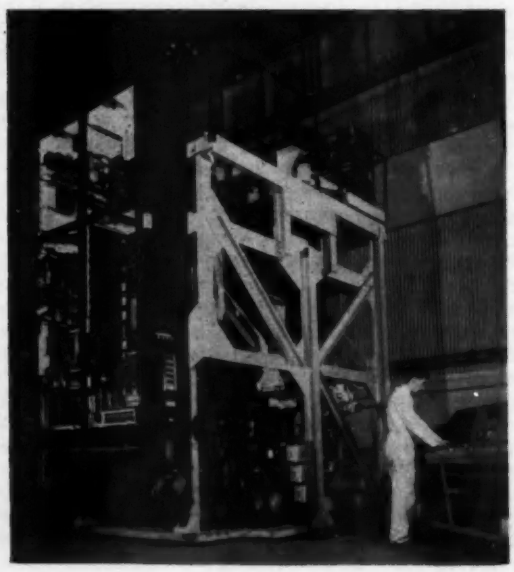


Fig. 1. Reactor fuelling machine for Hinkley Point power station erected for test at the maker's Whetstone works.

Tests being carried out on one of the reactor fuelling machines for Hinkley Point are shown in Fig. 1. The structure shown around the machine in this illustration is part of a test rig; in service on site, the fuel machine will be supported on the reactor floor by its own radiation shielding. The 90-ft. deep concrete-lined test pit is shown in Fig. 2, in which can be seen a control-rod winding mechanism being raised for examination after a test. The first charge/discharge machine for Hinkley Point was first subjected to tests about three months ago, and it is expected that these tests will continue for another nine months.

A somewhat similar test plant which for convenience has been installed at the English Electric works at Rugby, is designed for testing the reactor charge-hole-preparation machine. The function of this hole-preparation machine is to remove from the charge stand-pipes the sealing blocks and the control-rods and then lower the charge chute into the reactor for distributing the fuel to the group of channels needing replenishment. The charge chute includes a valve in its upper end which is operated by the charge machine to give access to the reactor. The test rig at Rugby is installed in a shaft

70 ft. deep and enables operating sequences to be repeated many times to ensure that accuracy and reliability of operation are achieved. The machine incorporates devices for dealing with emergency situations, and the operation of these devices is also tested.

Graphite machine shop

The graphite machine shop at Whetstone has been built to produce the requisite quantities of moderator graphite for nuclear power stations, both economically and accurately. The shop is laid out to accept the pure graphite raw material at one end, machine and inspect it under clean conditions, and pass it out at the other end to be packed in a store near Hinkley Point, ready for installation in the reactor. There are 308,000 graphite parts in the two Hinkley Point reactors. The maximum output for 1961 is stated to be at the rate of 7,000 parts per week. The machining operations are carried out in sequence using the latest unit heads built in special machine set-ups designed at Whetstone. Close tolerances are achieved, and inspections are made in one operation by instruments which show that all the many dimensions of the graphite brick or tile are within the prescribed limits.

Fig. 2 (left). Charge machinery test plant at Whetstone. Control rod winding mechanism is here seen being raised from the 90-ft. deep test pit for examination after simulation test under operating temperature and pressure conditions.

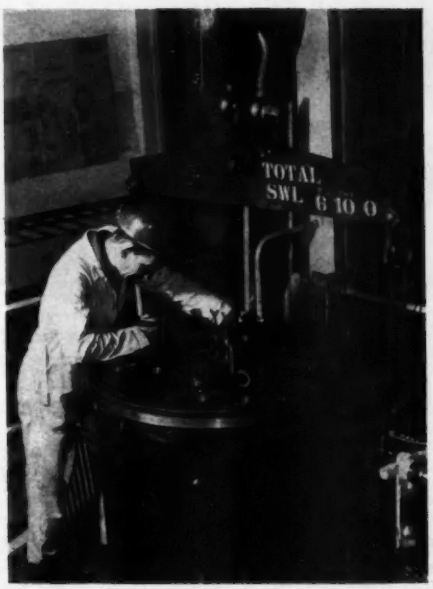


Fig. 3 (right). One of the actual hole-preparation machines for Hinkley Point being lowered into the 70-ft. deep shaft at Rugby works for testing.

Circulator test bed

Twelve single-stage axial blowers—(one for each gas-circuit in the reactors at Hinkley Point)—are being built at Whetstone by English Electric. Each completed machine is assembled on a test bed at Rugby (Fig. 4) and tested in air under atmospheric conditions. The axial-blower is driven on the rig by a 700 h.p. electric motor, and the measurements made include pressure ratio and mass flow to ensure that the performance of all machines is identical and reaches the requisite standards. The flow-path for the air in the rig is similar to the gas-path in the final installation at Hinkley Point. Air enters through an inlet duct into the annulus of the main casing. It is then accelerated through a 180° bend and passes through the inlet guide vanes, the rotating blades and the stator blades, then through a diffuser into the outlet duct. At Hinkley Point the blowers will be driven by 7,000 h.p. variable-speed induction motors to enable one ton of carbon-dioxide per second to be handled at a temperature of 178 deg. C. and a pressure of 200 lb./sq. in. g. in each of the twelve circuits.

Other rigs have been installed at Whetstone for establishing, proving, and testing the blower design. These include a half-scale model blower for establishing the design parameters for atomic power station circulators, and a circulator (blower) proving test rig to establish the mechanical design and reliability of bearings and static and rotating air-lubricated seals, under full reactor operating conditions of temperature, pressure and speed.

Steam turbine test

In the design of steam turbines for atomic power stations, the dual-pressure steam-cycle, evolved by Babcock & Wilcox Limited is used to gain maximum efficiency and optimum performance from the heat-exchangers, but it means that larger volumes of steam have to be dealt with for a given output; consequently, the low-pressure end of the turbine is correspondingly larger than for more conventional machines. At Hinkley Point power station nine turbo-alternators are being installed, six 93.5-MW (maximum capacity) main turbo-alternator units to supply power to the Supergrid and for the station auxiliaries, and three variable-frequency 33-MW (maximum capacity) sets to supply power for the main gas-circulators. One 33-MW set will be used to supply power for each reactor; the third will be a standby-set, and can be readily connected to either.

The main turbines are of the impulse/reaction type. At the design rating of 87-MW, the dual-cycle turbine stop-valve steam conditions are:—High-pressure 615 lb./sq. in. and 680 deg. F.; low-pressure 155 lb./sq. in.

and 655 deg. F.; vacuum 29 in. Hg. for cooling-water temperature 55 deg. F.; final feed temperature 166 deg. F.

Each turbine has a single h.p. cylinder and two double-flow l.p. cylinders solidly-coupled in line. Each double-flow l.p. cylinder exhausts into its own condenser. The l.p. steam is admitted through a mixing belt about half-way down the h.p. cylinder, and the temperature of the l.p. steam is such as to provide some measure of reheat by mixing with the cooler and partly-expanded h.p. steam.

The variable-frequency sets, having a controlled frequency range of 12½ to 50 c/s, are designed for an economic rating of 28-MW. The turbines are two cylinder impulse-reaction machines using high-pressure steam only, and exhausting directly to their own condensers. The condensate is not heated by bled steam from these sets but is pumped through the feed-heaters of the main sets.

The main alternators are hydrogen-cooled at 15 lb./sq. in. g. at the normal output of 87-MW at 0.85 p.f.; the gas pressure being raised to 25 lb./sq. in. g. at the maximum output of 93.5-MW. The alternators generate at 13.8-kV, and the main and pilot exciters are gear-driven from the main alternator shaft. The variable-frequency alternators generate at 11-kV and are rated at 33-MW at a power factor of 0.9 and a speed of 3,000 r.p.m. The capacity of the steam dumping plant at Hinkley Point is only 20 per cent. of the thermal output of one reactor, since the dump condensers are only needed to provide a heat sink for starting up, when the turbines are not running, and to cope with the shut-down heat production in the reactors. The turbine components are made in the Rugby works, machined and assembled into a complete unit on the test bed (Fig. 4) and the sets, together with their control gear, are tested at speeds equal to, and greater than, the normal running speed of 3,000 r.p.m.

"Saturn" computer

A variety of both analogue and digital computers are installed at Whetstone to enable studies to be made, *inter alia*, of the effects of the various relevant factors in the cost of nuclear power. The biggest of the analogue machines installed is "Saturn" which is believed to be the largest analogue computer in Europe. It is being used, for example, to study reactor instability problems, to assess problems of power station control and to under-

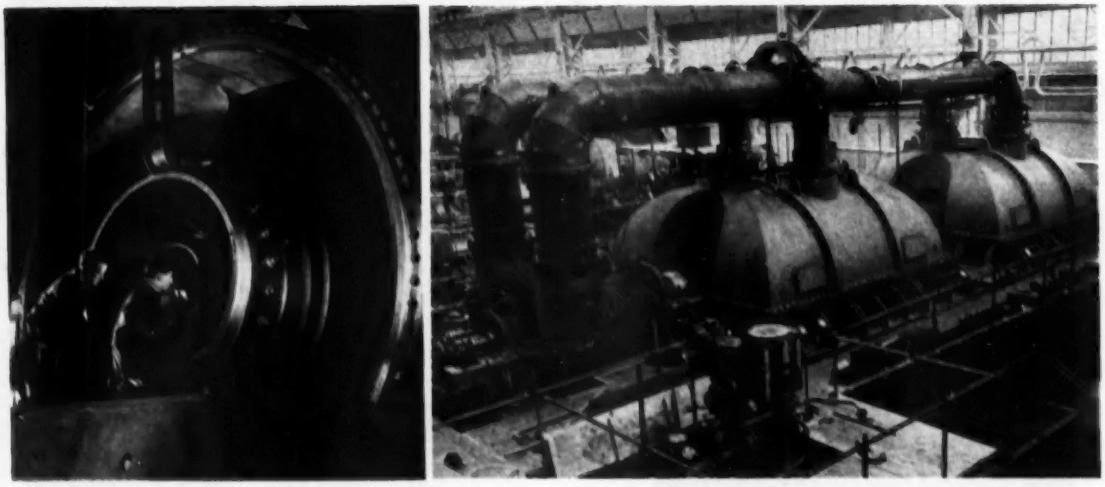
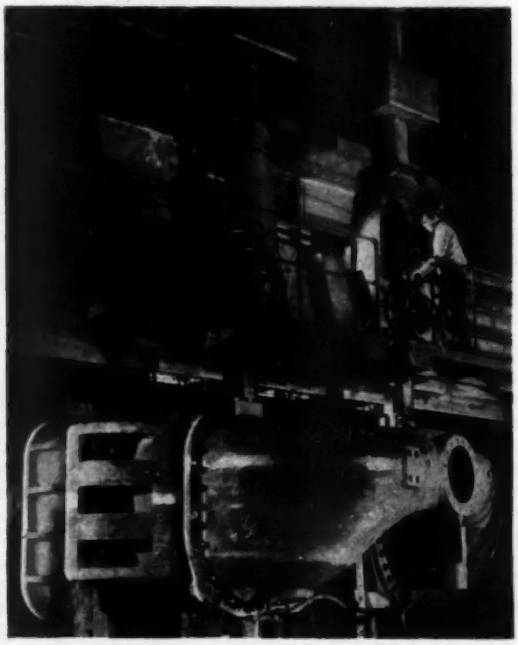


Fig. 4 (above). One of the six 93.5-MW main steam turbines for Hinkley Point, being prepared for test at Rugby Works of English Electric Company.

Fig. 5 (above, left). One of the twelve carbon-dioxide blowers for Hinkley Point being erected on test bed at Rugby.

Fig. 6 (below). A low-pressure exhaust chamber and top hood for one of the Hinkley Point turbines being bored at Rugby.



take the more complicated mathematical analysis of three-dimensional stress problems. It has been used for the solution of similar problems by a team from Atomics International, California.

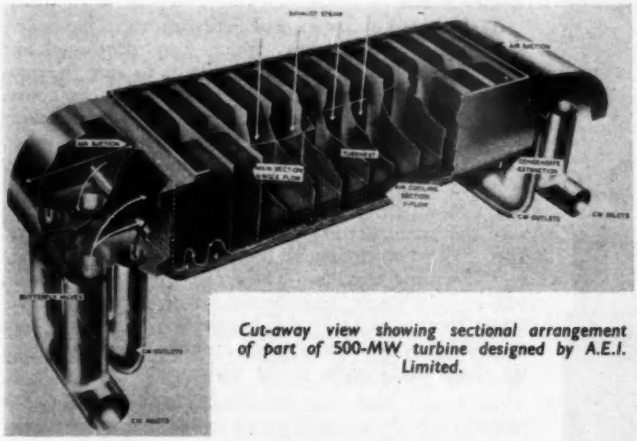
" Saturn," which has been built by English Electric Co. Ltd., at a cost of about £300,000, is a general purpose d.c. analogue computer having a basic capacity of 1,512 computing amplifiers and 192 servo multipliers. It is housed on the ground-floor and first-floor at one end of one of the research blocks at Whetstone. This ground-floor room, approximately 20 ft. × 40 ft. is the control room from which the computer is operated. Above it is a similar-sized room which contains all the computing components. The electronics room is air-conditioned, the temperature being stabilised at about 65 deg. F. All the equipment is mounted in nine vertical bays, each 6 ft. high, 15 ft. long and 2 ft. deep. Each bay is divided horizontally into eight separate racks, one above the other, and each rack is divided into twenty-one stations.

The bays are accessible from both sides, and the northern side of each bay contains the amplifiers, whilst the other side (back-of-panel stations) contains other units such as power stabilisers, multipliers, integrating capacitors and so on. Alongside each amplifier is a printed circuit " computer board " which carries standard input and feedback resistors for its neighbouring amplifier. These boards provide a basic range of fixed gains which can be reduced with the coefficient potentiometers in the control room. Biased semi-conductor diode function generators occupy one computer board position per rack. For large power outputs, a cathode follower can replace an amplifier and be used to boost the output of another amplifier. To enable amplifiers to be used as integrators, the feedback capacitors, which are housed in back-of-panel units, must be plugged into the correct stations. Servo multipliers also plug into back-of-panel stations and thus connect to the patchboard.

The control room contains a longitudinal facia panel divided into six sections. Each section controls the equipment in one-and-a-half bays in the electronics room. The sections are comprised essentially of a desk top, a patchboard and up to twenty-one control or monitoring units. The patchboard has facilities for 5,120 connections and is detachable for pre-patching. A routine maintenance procedure tests each component every three months.

NOVEL DESIGN OF SURFACE CONDENSERS

The Central Electricity Generating Board is placing an order worth £1½ million with **Associated Electrical Industries Limited** for four surface condensers for installation with four 500-MW steam turbines to be installed in one of the new Midlands power stations. The units ordered are of novel design, and mark a significant advance in the development of surface condensers intended to handle large quantities of exhaust steam from the very large turbines that are now being ordered by generating authorities in Britain and other highly-industrialised countries. Traditionally, condensers have always been placed transversely in the turbine foundations, and this had made it impossible to provide turbines with continuous supporting walls. However, the rapid increase in the unit size of power generating plant has made the provision of continuous support more important, whilst the increasing number of exhaust flows in these large machines has necessitated the use of two and even three condenser shells. With transversely arranged units, the problem of turbine support has, therefore, become more and more difficult.



Cut-away view showing sectional arrangement of part of 500-MW turbine designed by A.E.I. Limited.

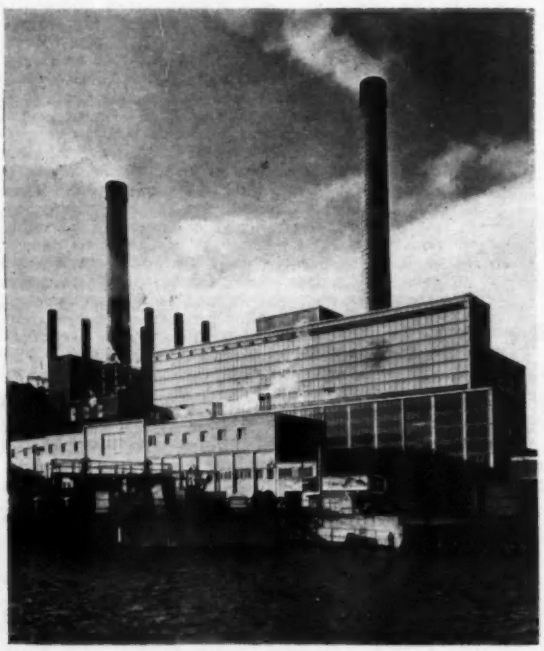
The new A.E.I. condensing units have been designed with the aim of overcoming this problem. Single-shell units which will be arranged parallel to the turbine axis, and housed within the foundation-block supporting walls have been developed. This arrangement has made it necessary to employ a single water-pass in the condenser tubes and, though this has the advantage of making the condensers lighter and more compact it also presents technical problems that have to be overcome. As, in a single-pass condenser, one end of the tubes is at an appreciably higher temperature than the other, the most serious problem is that of differential heat-flow between the two ends. Theoretically this could be overcome by the provision of a graduated increase of heat-transfer area throughout the length of the unit. In practice this is not practicable, and the problem has had to be resolved in other ways. In this connection it is of interest that the differential heat-flow problem also occurs, though less markedly, in two-pass units. The principle which has been developed to overcome it was employed by A.E.I. in the two-flow transverse condensers built for Castle Donington Power Station (near Derby). The performance of these condensers, which have contributed to this station's record of high average overall thermal efficiency, has provided substantial confirmation of the soundness of the system. Another of the design difficulties in a single-pass condenser is the efficient deaeration of the condensate. This, too, has been overcome, and the condensate flow path has been so arranged that a degree of deaeration equal to that obtained in the best two-pass units is expected. The fact that air and incondensable gases have a lower rate of heat transfer than wet steam, presents problems to the condenser designer. Provision has been made for this in the new units by using multi-pass water-flows in the section of the tube nest where they are concentrated. This will result in a significant saving in cooling-water requirement which should be appreciably below that in conventionally-designed condensers of similar capacity. The new design incorporates twin tube-nests and, in accordance with normal practice, provision has been made for separate air-extraction from each. This will permit cleaning of one nest whilst the other is in commission. The extraction of air and incondensable gases will be by means of A.E.I. Le Blanc rotary air-pumps. Each pump will be capable of extraction at the rate of 150 lb./hr. The total heat transfer surface in each condenser will amount to approximately 300,000 sq. ft. while the quantity of cooling-water circulated will be 200,000 gal./min.

Spondon "H" Power Station

IN the issue of this journal for February last, we published some general and technical details of Spondon "H" (Heat) Power Station, with particular reference to the four 180,000 lb./hr. dual natural-circulation boilers, and the three 10,120 kW back-pressure turbo-alternators, which are designed to supply a maximum of 600,000 lb./hr. of process steam to the adjacent factory of Courtaulds Limited (formerly that of British Celanese Limited).

Since then, we were able to pay a further visit to the station, which was officially opened on April 21st, by Sir Robertson King, K.B.E., chairman of the Electricity Council.

Spondon "H" is unique among the power stations of the C.E.G.B., in that it is designed to supply, in large quantity, back-pressure steam to an industrial organisation. The Courtauld company has a long term contract with the C.E.G.B., to take up to the above mentioned quantity of steam per hour from the station. Implicit in the contract is the condition that no condensate is returned from the factory which, instead, supplies make-up in the form of warm river-water. Operation of the station is based on the factory demand for steam, bearing in mind that the factory normally works continuously, with a three-shift seven-day week, and is only shut down about once a year for a three-day maintenance period. To allow for any maintenance work on the turbines and boilers, without causing any interruption in the supply of steam to the factory, the main plant installed at Spondon "H" comprises four 180,000 lb./hr. boilers and three back-pressure turbo-alternators. To by-pass the turbines, when required, there are three pressure-reducing valves and secondary desuperheaters.



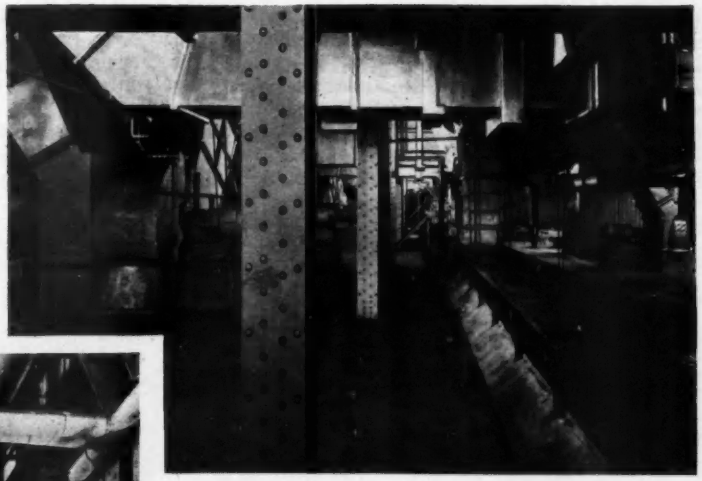
Spondon "H" power station which was officially opened on April 21st. The steel chimneys at the left of the illustration are those serving the boiler plant at the older "A" station.

Raw make-up water is taken from the River Derwent, through the factory's process systems, at a temperature ranging from 125-140 deg. F., and is pumped into the water-treatment plant by raw-water booster-pumps installed in the station compound, near the boundary separating it from the factory. Because of the 100 per cent. make-up requirement, this water treatment plant is probably the largest in any of the C.E.G.B. stations. The plant, which was supplied by The Permutit Co. Ltd., has a maximum continuous throughput of 765,000 lb./hr., and the treated water is delivered at a temperature of about 228 deg. F. Treatment is carried out sequentially, in hot pressure, lime-reaction water-softeners followed by pressure filters, and then hot base-exchange "Zeolite" water-softeners. There are two lime-reaction tanks, eight filter units and three base-exchange softeners, with three booster pumps at the discharge side of the filters. To allow for maintenance, the plant is designed to give a throughput of 500,000 lb./hr., with one lime-reaction tank, one filter unit and one base-exchange softener out of service. Most of the heat required for the water-softening process is derived from blow-down steam, and constant pressure is maintained in the reaction tanks by an auxiliary steam supply with a pressure-reducing valve. Meters, supplied by Bailey Meters & Controls Ltd., provide a means for automatic electro-mechanical control of the lime cream dose in proportion to the rate of raw-water intake to the hot lime-reaction tanks, but to cope with changes in quality of the raw-water, manual adjustment of the dose is also required. To avoid pick-up of silica by the hot alkaline liquor, graded anthracite is used instead of sand in the fuel beds.

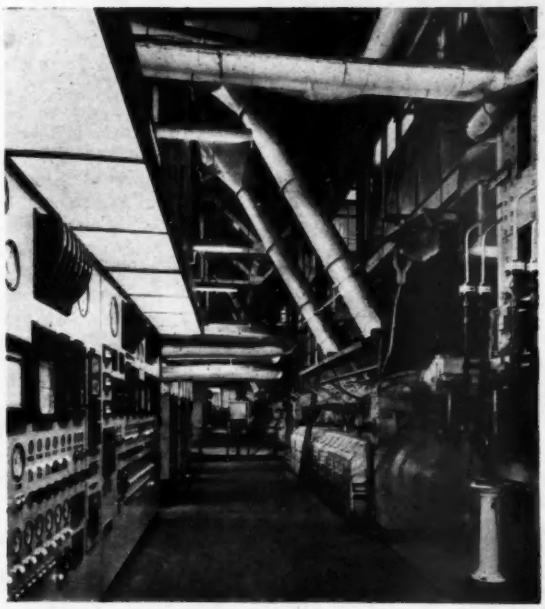
Boiler plant

As described in our issue of February, 1961, the boilers are dual circulation units which were developed and supplied by Foster Wheeler Limited, to suit the properties of the feedwater treatment plant described above. They are three-drum water-tube boilers fired by travelling chain-grate stokers made by International Combustion Limited. Each boiler has a maximum continuous rating of 180,000 lb./hr. when operating at superheater outlet steam conditions of 950 lb./sq. in., and 895 deg. F., and with water temperature of 360 deg. F. at the economiser inlet. The dual circulation boiler consists of two separate heat-absorbing circuits. The front, or primary circuit, consists of a single steam-and-water-drum, and a superheater section, and in it a concentration of solids is kept at a relatively low value by continuous blowdown from the front steam-drum to the rear steam-drum through

(Right). Boiler-house basement at Spondon "H," showing submerged ash-conveyor supplied by John Thompson Conveyor Co. Ltd., and also one of the James Howden forced-draught fans.

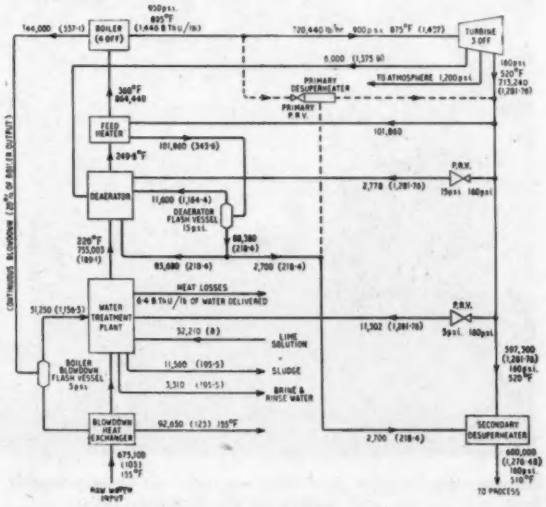


(Below). View along boiler firing aisle in front of the three Foster Wheeler boilers fired by International Combustion Limited L-type stokers.



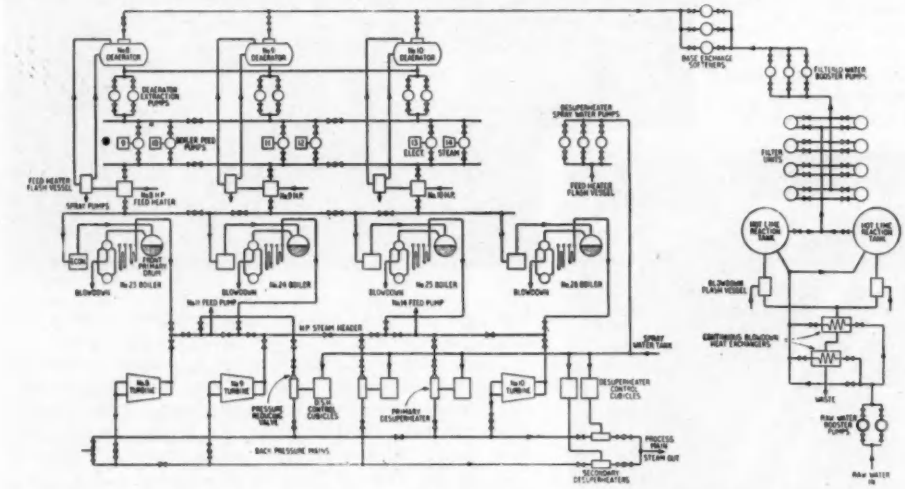
six 4-in. o.d. water-circulators—flow being achieved by placing the rear drum centre-line 5 in. below that of the front drum. Steam generated in the rear drum is led from the front drum through thirty-eight 3¼ in. o.d. tubes, and there is no carry-over of silica or other solids. The steam enters a separate compartment in the side of the drum where it serves to raise the temperature of the incoming feed, which is sprayed from the feed pipe, and is itself partially condensed. The primary or low-concentration circuit is formed by the furnace water-walls which consist of open-spaced 3¼ in. o.d. tubes. Water from the front steam drum is fed to the front, rear and side walls of the furnace by a 10¾ in. i.d. down-comer on either side of the boiler. The front and rear-wall tubes lead directly into the drum at their upper end; the front-wall tubes also form the roof tubes, and the rear-wall tubes open out to form a two-row screen at the furnace exit. At the level of the water-drum, the rear-wall begins to slope towards the front-wall and becomes vertical again at the front steam-drum centre-line. Some of the side-wall tubes extend up the furnace roof and so directly into the drum; the remainder go into a header at approximately the same height as the point where the rear-wall becomes vertical again. Risers convey the steam/water mixing from this header to the drum.

The second or highly-concentrated circuit comprises two vertical convection banks of 2 in. tubes between the rear steam-drum and the water-drum, water flowing down the bank furthest from the furnace and up the front bank. A row of 3¼ in. tubes connected between these drums serves to line the superheater cavity. Two 6-in. bore downcomers are connected (one each side) between the steam and water drums to assist circulation in the convection bank. Steam temperature is controlled by condensing a small proportion of the saturated steam before entry in the superheater. The moisture thus formed mixes with the incoming saturated steam, and by taking up latent heat in the superheater, reduces the final overall steam temperature to the required value.



Heat balance diagram for the three 180,000 lb./hr. boilers and three 10,120-kW back-pressure turbo-alternator sets supplying up to 600,000 lb./hr. of steam for process requirements.

Condensation of the necessary quantity of saturated steam is carried out by means of a shell and tube type heat-exchanger, or control condenser, which forms the superheater inlet header. Saturated steam entering this header passes over a horizontal tube bundle carrying circulated cool feedwater which by-passes the economiser, and flows via the control condenser to rejoin the main feed flow at a point between the economiser outlet and the steam drum. Up to 20 per cent. of the boiler evaporation is continuously blown down from the secondary section to flash out the silica and other solids, and is taken through the blow-down flash vessels and heat-exchangers before being discharged to waste. Steam flashed off in the blowdown flash vessels heats the raw water in the lime reaction tanks. The total blowdown from four boilers is 144,000 lb./hr., from which flash steam is produced at a rate of 51,250 lb./hr., and the incoming raw water (675,000 lb./hr.) is heated 10 deg. F.

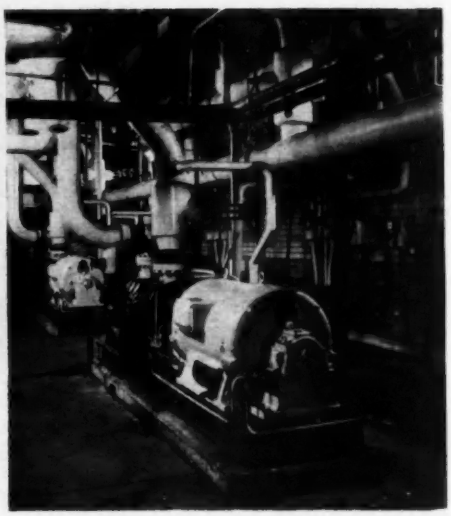


Diagrammatic lay-out showing arrangements of steam and water circuits at Spondon "H" (heat) power station.

Coal-handling plant

The coal-handling plant was manufactured and supplied by International Combustion Products Limited, and is designed to handle 150 tons/hr. of coal into the boiler bunkers or to the storage area. Provision has been made for handling both road and rail-borne coal. One feature of this plant is that no wagon-tipplers have been provided since all the rail-borne coal arrives at the site in hopper-bottomed railway wagons, which discharge into twin track hoppers. Under these hoppers are fitted vibrating feeders which deliver the coal on to two 24-in. belt-conveyors each capable of handling 150 tons/hr. These twin-belt conveyors are carried in sheeted gantries and deliver the coal on

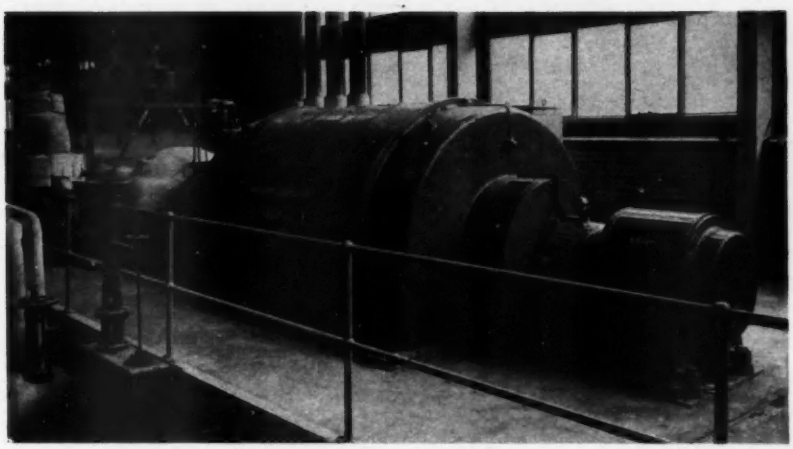
(Above). Hot pressure filters and pumps for the water treatment plant, which was supplied by The Permutit Co. Ltd.



(Right). There are six 300,000 lb./hr. boiler feed pumps, all supplied by Sulzer Bros. (London) Limited, four being electrically driven and two steam driven.

to two shuttle conveyors positioned immediately over the boiler bunkers. The shuttle conveyors can deliver into any one of the four main bunkers. A trip-off point is provided in a junction tower for delivering coal to stock by means of a 24-in. 150 tons/hr. belt. When reclaiming from the storage area, the coal is delivered to a ground hopper by mobile coal-handling plant. A syntron feeder then delivers the coal on to either of the duplicate 24-in. belts previously mentioned. Coal sampling is effected by a Pollock machine which employs the method of taking samples direct from the belt conveyors.

The coal-handling conveyor motors were supplied by Lancashire Dynamo & Crypto Limited; they are driven through Vulcan-Sinclair fluid couplings supplied by Fluidrive Engineering Co. Ltd. For four of the conveyors, there are size 16.25 couplings to transmit 25 h.p. at 960 r.p.m., and for the other two conveyors size 14.5 couplings transmit 12½ h.p. at 960 r.p.m. Incidentally, a Vulcan-Sinclair size 16.25 fluid coupling unit rated at 7½ h.p. at 720 r.p.m. is also supplied for the motor driving the ash-conveyor.



One of the three 10,120-kW back-pressure turbo-alternator sets which were supplied by A.E.I. Limited

Ash-handling plant

The ash and dust-handling plants were supplied by the John Thompson Conveyor Company. Ash from the chain-grate stokers is deposited through hoppers into a water-submerged ash-conveyor, and ultimately discharges into the 100-ton capacity ash storage-bunker by means of an inclined conveyor. The dust plant which has a capacity of 12 tons/hr. uses pneumatic suction to collect dust from the boiler dust-hoppers, economisers and air-heater hoppers as well as from the Davidson grit-arresters and the chimney. The dust is finally discharged into the two 12-ton capacity dust container filter units located on top of the dust bunker. Dust from these containers is conditioned with water to prevent dust nuisance, and is then discharged into the ash-hopper where it is mixed with the furnace ash before being discharged into transport lorries.

Turbo-alternators

Steam is supplied at 900 lb./sq. in. and 875 deg. F. to each of the three single-cylinder back-pressure turbo-alternators, which were supplied by Associated Electrical Industries Limited. Each machine has a continuous maximum rating of 10,120-kW and the steam conditions at the turbine exhaust are 160 lb./sq. in. at 520 deg. F. Electrical power is generated at 11.8-kV and the alternator is cooled by a closed air circuit, the air being water-cooled. Low-pressure steam from the turbine exhausts passes into two 21-in. back-pressure steam mains which are connected through a single 30-in. main to serve the Courtauld factory. During any period in which the turbine is shut down, steam is supplied directly from the boilers to the process steam main through three Hopkinson pressure-reducing valves and primary desuperheaters, each rated at 250,000 lb./hr., the exhaust steam conditions being 170 lb./sq. in. at 520 deg. F. The steam is finally conditioned by two secondary desuperheaters (one in each of the 21 in. back-pressure mains) each rated at 600,000 lb./hr. and designed to trim the final temperature to 510 deg. F. The steam pressure is controlled at the turbine by a pilot valve mounted on a spring-loaded diaphragm which allows ± 10 deg. adjustment of the pre-set pressure and which alters the steam admission to the turbine in response to any change in back-pressure.

In order to provide a short term emergency supply of steam to the factory in the event of a complete stoppage of steam supplies from Spondon " H," pressure reducing and desuperheating equipment is installed to take steam from the boilers in Spondon " A " station at 375 lb./sq. in. and 750 deg. F.

Boiler feed pumps

There are six boiler feed pumps each of 300,000 lb./hr. capacity, all supplied by Sulzer Bros. (London) Limited. Four of these pumps are driven by 600 h.p., 3,300 V, 2,950 r.p.m. induction motors supplied by Associated Electrical Industries Limited, while the other two are driven by back-pressure steam turbines supplied by G. & J. Weir Limited. All the pumps are of the multi-stage centrifugal type—the electrically-driven pumps having eleven stages, and the turbo-driven units five stages.

Steam piping

The high and low-pressure pipework for steam and water was fabricated and erected by Aiton & Co. Ltd. An 8-in. bore steam main from each boiler is connected to a 12-in. steam header and steam is fed from the header to each of the turbines through an 8-in. main. All high-pressure steam pipes are manufactured from 1 per cent. chromium, ½ per cent. molybdenum steel. Low-pressure steam from the turbines is passed through a 16-in. bore pipe to one of the two parallel connected 21-in. back-pressure steam mains which join the single 30-in. bore main serving the Courtaulds factory.

The heat insulation of the pipework, including the 2,140-ft. run of 30-in. dia. main steam line to the factory, was carried out by Thomas Cotton Limited, using Caposite Rocksil thermal insulation materials supplied by Cape Insulation & Asbestos Products Limited. For the 30-in. steam main, Caposite asbestos bevelled lags 3½-in. thick were used. Secured by 1-in. mesh wire netting, the insulation material is coated with a ½-in. thickness of hard-setting composition. For the 22-in. and 16-in. steam mains 3½-in. thick "Rocksil" wire matrices were used, these being secured by heavy-gauge lacing wire. The 12-in. mains were insulated with 3-in. thick Rocksil flexible sections with Caposite spacers. "Noral" 2 S.H. aluminium sheet 0.036 in. thick was used to give a protective finish to all insulated mains. Supplied by Alcon Industries Limited, in coil form, lengths are wrapped circumferentially round the mains, leaving a 2-in. overlap and joined by "pop" rivets.

The combined installed generating capacity of the two stations, Spondon "A" and "H" is 203.36-MW. Most of this output is used locally, and any surplus is exported through the 132-kV grid sub-station.

Spondon "H" power station was designed by the engineering department of the East Midlands Division, and by the Midlands Project Group of the C.E.G.B. Work on the site was started in July, 1956, and the last boiler and back-pressure turbo-alternator set were commissioned during the autumn of 1960. The architects are Cecil Howett and Partners.

Official opening

At the official opening ceremony, the guests were welcomed by Mr. O. S. Woods (Divisional Controller, East Midlands Division), at whose request Sir Robertson King unveiled a plaque commemorating the ceremony. Among the guests, who represented a wide range of industry and commerce, were Lord Citrine, P.C., G.B.E. (a part time member of the Electricity Council, and from 1948 to 1957 chairman of the Central Electricity Authority); the Mayor and Mayoress of Derby; Mr. F. H. S. Brown, C.B.E., and Mr. A. R. Cooper (members of the Central Electricity Generating Board), and Mr. R. L. Batley, O.B.E. (regional director, Midlands and East Midlands Region).

Sir Robertson King recalled that he was speaking within the precincts of the generating station which the company he served for so many years, bought from British Celanese Limited in 1922. The old Spondon station, now known as the "A" station, was built by the forerunner of Celanese—the British Cellulose and Chemical Manufacturing Co. Ltd., in 1916, to supply electricity for a carbide factory as part of the war effort. It was purchased by the Derbyshire and Nottinghamshire Electric Power Company from British Celanese in 1922. It was in 1943 that the first discussions took place which ultimately led to the design and erection of Spondon "H." But owing to the war and its consequences, the project was not proceeded with until 1952.

This dual use of the steam at Spondon "H" boosts the efficiency of electricity generation at the station, and it may well be somewhere around 60 per cent., said Sir Robertson. The average thermal efficiency of a group of the Board's largest and most efficient stations last year was 31.49 per cent.; although some of the new stations now being constructed with very large boiler turbine units were expected to reach a figure approaching 40 per cent. But Spondon "H" should not be compared with a modern electricity generating station which was constructed to generate electricity only, and as cheaply as possible. "It is very rare indeed that one will find on a suitable site in this country, a factory requiring large quantities of steam every day and every hour throughout the year, as well as large quantities of electricity at

(Above). Mimic diagram and electric control panels in plant main control room at Spondon "H."

(Right). Sir Robertson King, chairman of the Electricity Council, unveils a plaque commemorating the opening ceremony at the station on April 21st.

precisely the same time." Sir Robertson made this comparison of thermal efficiencies to prevent other people from making mis-leading comparisons. A large electricity generating station of the type now being erected by the C.E.G.B. would produce perhaps as much as 70 times more electricity than Spondon "H" station where the production of electricity was so closely tied to the production of steam for process requirements.

Replying for the guests, Mr. C. E. H. Verity, O.B.E., managing director, Foster Wheeler Limited, said the power station was a first-rate advertisement for British industry, and a tribute to all those men whose efforts contributed in any way to its construction.

British Coal Utilisation Research Association

THE annual report of the British Coal Utilisation Research Association, covering the year ended December 31st, 1960, records good progress in research projects aimed at improving the competitive position of coal, and emphasises the work carried out during the year on the automatic industrial boiler, and the small automatic chain-grate stoker for firing boilers serving the heating requirements of large buildings. In addition the research into the complete gasification of low-grade coal, under contract with the Ministry of Power, has been continued. The study of automatic and mechanised boiler plant which was started in 1959, has been extended in the fields of coal and ash-handling, and automatic control of combustion, and the two-pass Economic type boiler installed at the Association's Leatherhead centre has now been fitted with handling plant and automatic controls. Commercially-available equipment has been selected wherever possible, the prime objective being to test and develop this equipment as part of an integrated unit.

The coal-bunker now serving this boiler has two outlets, in order to increase flexibility, and also to avoid undue weight without requiring excessive excavation. Different coal-feeding devices are being tested on the two bunker outlets; one being a standard industrial "gate" to regulate flow with a vibratory feeder, whilst the other is a static gravity-feed system. Various modifications to the latter including cone-shaped constrictions in the bunker throat, similar to the Bituminous Coal Research "Easi-flo" system, are under test. The flow characteristics are being examined by means of a Perspex model. A combustion control unit, governing the coal feed-rate and air-flow from the steam pressure, has also been installed. The investigations into stoker performance at low load, and on the control of combustion, are a necessary preliminary to boiler trials with complete control systems over a wide range of load.

A full report on the work leading to the construction of the integrated unit has been prepared. The performance of the unit will now be studied at various loads and with coals of different moisture, ash, and fines content. The effect of transient changes in these characteristics will be studied. Meanwhile, it is proposed to use the new three-pass Economic-type boiler, now installed, for further development work, and particularly, for evaluating different forms of combustion control.

In research aimed at improving the availability of water-tube boilers, the emphasis, during the period under review, has been on the study of deposit formation. Laboratory experiments have been carried out on equipment burning from $\frac{1}{4}$ to 50 lb./hr. of pulverised fuel. An oil-fired combustor, designed to burn up to 70 lb./hr. of fuel-oil, having a viscosity of 1,000 secs., has been commissioned and is being used in tests designed to determine the mechanisms by which certain techniques for reducing sulphur trioxide formation achieve their objective. Trials have continued into the corrosion problem at Barking Power Station, with a test rig attached to a stoker-fired boiler, and also with an oil-fired boiler, having an evaporative capacity of 340,000 lb./hr., at Poole Power Station.

Field trials of the small automatic chain-grate stoker, using $\frac{1}{2}$ in. to 0 in. washed coals, were satisfactorily completed. This stoker is intended for use with boilers employed in heating large buildings, where skilled attention is not normally available. The tests produced combustion efficiencies in the range 74-86 per cent., and the fuel costs, compared with those previously incurred for the same heating service, showed a saving of 30 per cent. Under an agreement with the Association, arrangements for the commercial development of the small automatic chain-grate stoker and associated equipment are being made by the National Coal Board. With the conclusion of the experimental work on the chain-grate stoker in 1961, increased emphasis will be placed on the investigation of the single house central-heating boiler, and preliminary work has included a critical survey of the types now available.

Since 1956, research on some of the problems concerning the total gasification of coal has been carried out under a contract from the Ministry of Power. Attention has been directed particularly to the tuyére and hearth zone of slagging fixed-bed gasification processes, and to the tapping and quenching of slag. This work has been commended by the (Wilson) Committee on Coal Derivatives. Much of the work has been carried out on an experimental gasifier, and has included measurements of the temperature-viscosity characteristics of slags, and studies of their correlation with chemical composition. In co-operation with the Central Electricity Generating Board in a series of trials at Barking Power Station, information has been obtained on the relation of the behaviour of a coal in a cyclone furnace, to the viscous properties of its ash. The tests were carried out with 4,000-ton batches of three coals, selected primarily on the basis of the silica ratios of their ashes, which were in the range 50-60, 60-70 and 70-80, respectively. During each trial, numerous samples of coals and slags were taken by the C.E.G.B. and submitted to the Association for analysis, and the flow properties of the slags were examined in the slag viscometer.

A preliminary study of the distribution of incombustible matter in the size fractions of pulverised-coal below 200-mesh has thrown light on the association between the

mineral matter and the pure coal substance; work in this connection is being continued. Further advances have been made in understanding the structure of the coal molecule, while some study has been devoted to a study of the relation between the plastic softening of coals and their chemical constitution.

An arrangement has been made with the Central Electricity Research Laboratories at Leatherhead for preparation in the B.C.U.R.A. laboratories of graphite samples, using the special techniques that have been developed to provide shaped specimens free from contamination.

The report gives abstracts of fifty of the Association's reports and published papers as well as a list of personnel of the council, the various committees and members, and the Association's research staff.

In the general section, reference is made to a visit made by H.R.H. The Duke of Edinburgh, to the research station on May 13th. He was met by the Association's president and by the Rt. Hon. Lord Hailsham, Minister for Science.

The balance sheet and statement of accounts show an increase since last year of just over £26,000 in the total income (£452,000); this was due mainly to income from contracts and fully-endowed research. Copies of the report, price 10s., may be obtained from the liaison and publications officer, British Coal Utilisation Research Association, Randalls Road, Leatherhead, Surrey.

The Institution of Plant Engineers

THE fourteenth annual conference of the Institution of Plant Engineers was held at the Imperial Hotel, Blackpool, from April 19th-21st. In accordance with the procedure adopted at previous conferences, the afternoon of the first day was devoted to the Branch Secretaries' Conference and to the annual general meeting of the Institution. During the evening, a civic reception followed by dancing, was given by the Mayor and Mayoress of Blackpool. On the second day, prior to the technical sessions, Mr. G. D. Jordon, M.Eng., A.M.I.Mech.E., etc., was installed as the fifteenth president, and afterwards gave his presidential address.

Technical sessions

The technical sessions which followed the presidential address commenced with a paper by Dr. K. J. Irvine, Ph.D., B.Sc. (deputy research manager, The United Steel Companies Limited) entitled "Causes and Prevention of Corrosion." In the ensuing discussion, considerable exchanges took place concerning the main points put forward by Dr. Irvine, and dealing with many different forms of corrosion, and the causes and prevention thereof. The president proposed a vote of thanks to Dr. Irvine, for his most informative paper.

Discussion groups

The afternoon of April 20th was occupied by four simultaneous discussion-group meetings, all well attended. These four discussion groups were respectively entitled: (a) "The Provision of Specialist Information"—the discussion being opened by Dr. D. Clayton, D.Sc., M.I.Mech.E. (Engineering Development Manager, I.C.I. Limited, Billingham Division); (b) "Broadening the Engineers' Outlook"—this discussion being led by Mr. W. K. Martin, B.Sc.(Eng.), M.I.Mech.E., M.I.Plant E. (Chief Engineer, John Player & Sons, branch of The Imperial Tobacco Co. [of Great Britain and Ireland] Ltd.); (c) "Simplification of Maintenance Planning Methods"—opened by Mr. H. S. Sayles, M.A.(Cantab.), M.I.Plant E. (Works Engineer, I.C.I. Limited, Nobel Division, Ardeer Factory); and (d) "Utilisation and Development of Engineering Methods of Lifting"—this group being led by Mr. G. L. Mitchell, M.I.Mech.E., M.I.Plant E. (Managing Director, Hills Plant Limited).

Lively discussions took place at each of these four group meetings and the group proceedings were summarised during the morning of the following day.

The conference dinner

About 330 members and guests attended the conference dinner, at which, after the loyal toast by the president, Mr. T. S. Kilpatrick, M.A., who was the principal guest, proposed "The Institution." Mr. Kilpatrick, who is a director and general manager of Steel, Peech & Tozer, branch of the United Steel Companies Limited, said that he considered it not only a great honour to be asked to propose "The Institution," but also a very particular and pleasant one, as the new president is a member of his (Mr. Kilpatrick's) own firm, and he cannot help but share a little of his (the president's) pride in the office to which members of the Institution had elected him. Continuing, Mr. Kilpatrick made reference to the Iron and Steel industry, which, until comparatively recently, was not, or so it seemed from the problems they have had on recruitment, terribly attractive to the professional engineer. There seemed to be a feeling amongst them that the engineer in this heavy industry was concerned only with maintenance, and was unable to exercise his full talents in what to many were the more interesting sides of the profession, such as design and development. His firm had, said Mr. Kilpatrick, encountered quite a problem in the past in recruiting good young engineers, and for that reason, they introduced, some years ago, a training scheme whereby these young men were seconded for a year or more, during their initial training, to some of the better-known engineering firms in this country, and this system is, indeed, still followed.

Mr. Kilpatrick said that his plea to the plant engineer would be that it is not only important to design correctly, to build robustly, but very particularly to build so that the diagnosis of trouble is easy, and the remedy can be swiftly applied. When something goes wrong with any section or item of works plant or machinery, it may necessitate the attention of the fuel engineer, the mechanical engineer, a hydraulic engineer or an electrical engineer. But it is obvious that because all of these cannot be on the spot at the same time, it is necessary to have someone who is as nearly as possible all these things at once.

How then do we recognise the plant engineer ? He is the man who gets the plant or machinery operating within, perhaps, minutes, instead of hours, owing to his being able to diagnose the exact trouble quickly and correctly and overcome the trouble speedily. In referring to the new president (Mr. Jordon), Mr. Kilpatrick said he is currently acting as the organising secretary for all the engineering work behind a £10¾ million project designed to replace all the ageing open-hearth furnaces at his company's Rotherham works and replace them by a few of the largest electric furnaces in the world. Completion of the project will make the company the largest electric steelmakers in the world by the end of 1965. This is only one of the many projects, albeit a large one, which are at present being carried out, and which four years hence will raise the capital value of plant behind each and every one of the company's employees from £4,200 to £5,900 per man.

Thus, the new president, whilst fully occupied with these new developments, will, of necessity, have to devote quite an amount of time and effort to Institution business. Mr. Kilpatrick said that in the interests of the Institution, his company would have to be prepared to agree to this course.

Replying to the toast " The Institution," the president thanked Mr. Kilpatrick for finding the time, from a heavy programme, to be their principal guest. In considering what to say in reply to the toast, Mr. Jordon said he thought of all the things the Institution has done since its inception. They have had annual reports of membership increasing year-by-year to its present figure of more than 4,000. Their efforts in the field of education and training had met with great success, as had the work of those responsible for devising branch programmes, and the work of council and committee working energetically in laying down policy, and making changes here and there to improve status and encourage development.

Why do we all do it ? Why does the Institution attract men from widely varying industries with all combinations of opinion and experience ? The clue must lie in what we do together, what we can offer each other, not only in terms of knowledge and ideas, but more so in the feeling that the isolation to which the plant engineer is subject, can be made more tolerable by sharing one's doubts and difficulties with men in similar circumstances. The medium of discussion is much more conductive to the exchange of knowledge and experience, and to the resolution of a problem, than the written word for which there is little enough time to swallow let alone digest.

We can be proud of what we have achieved. This must, indeed, be consolidated, but ahead of us there is a great deal to be done, and we must never let up in our forward thinking.

The toast " The Guests " was proposed by Mr. J. C. Veale, M.Eng. A.M.Inst.C.E., M.I.Mech.E., F.Inst.-Plant E. (past president) and was replied to by the Deputy Mayor of Blackpool, Councillor A. Ashworth.

In his address, Mr. Jordon said it was his sincere hope that he will not fail to preserve the high standards set by his predecessors, nor fail to interpret the aspirations of the members. It has been his privilege, said Mr. Jordon, through the whole of his working career, to be employed within the steel industry—one in which we can trace the many changes and advances caused by both the old and new industrial revolutions. Since the war, the steel industry has spent some £900 million on development, and has committed itself to a further £450 million by 1965. Its capacity is expected to rise from some 26 million ingot tons, to more than 34 million tons, by 1965. The investments have been made not only with the object of increasing output but also, and perhaps far more important, to raise efficiency. Productivity as measured by the volume of output per man year, has risen significantly, but at the same time, so has the ratio of administrative staff to operatives. While the management side of industry has been faced with so many problems of complexity and control, so have the engineering departments. The chief engineer of the integrated steelworks has a vast network of activities to control. Plant design and development, major capital schemes with all their civil, electrical and mechanical engineering aspects, and the maintenance of plant which is expected to be fully productive for 350 days out of every 365, are all responsibilities making the engineering department a vital section of the organisation.

The Institution of Plant Engineers recognises the breadth of knowledge required by the plant and works engineer, knowledge which in many medium and small size industrial units is vested in one man.

We as an institution are, said Mr. Jordon, still young, and as such are, and he hoped always will be, refreshingly different. In terms of types of industry, experience, and academic ability, it recognises a very wide range of people and functions. The Institution activities are correspondingly diversified and it is fortunate in having a membership which is not only interested in the progress of the Institution, but is also willing to voice its feelings in the interests of progress.

Mr. Jordon concluded by saying that he had the greatest confidence for the future of the Institution. It has a sound membership which is growing steadily, and which is playing a major role in promoting the productive efficiency of this country.

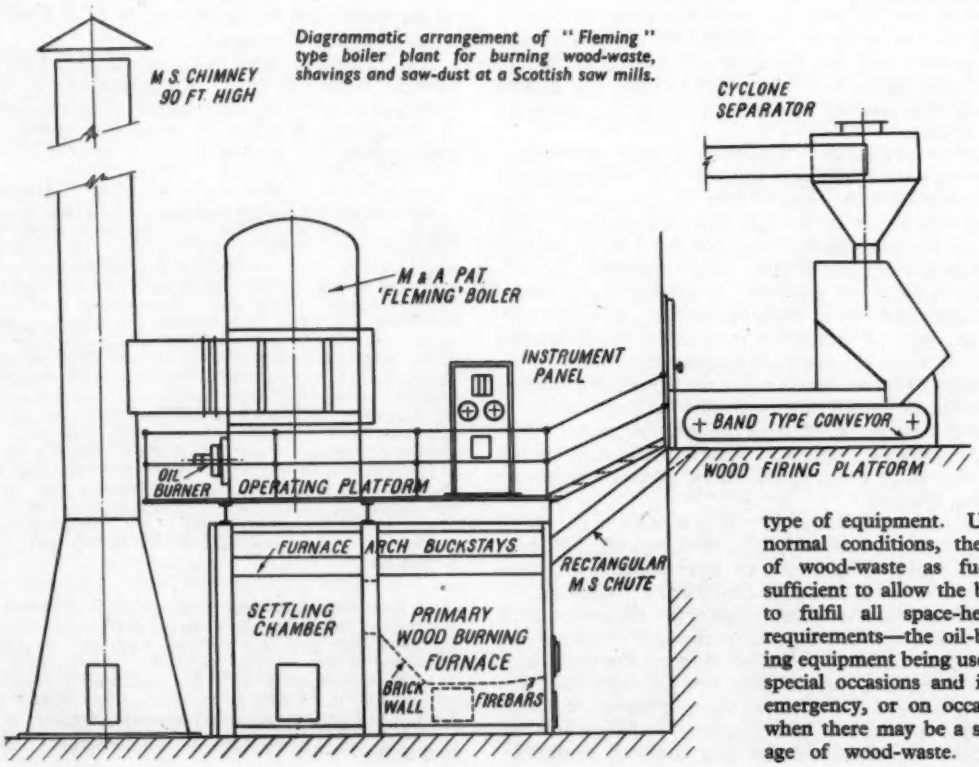
Associated Electrical Industries Limited is to supply another (the third) 300-MW turbo-alternator set for the West Thurrock Power Station of the C.E.G.B. The order is valued at £2.3 million, and the machine will be similar to two other machines already being made by A.E.I. for this station. This brings the total value of the orders received by the company for West Thurrock to more than £7 million. This order follows one for two 125-MW machines for South Africa. Other large generating units at present being manufactured by A.E.I. include 375-MW and 550-MW machines for Britain, two 300-MW units for Canada, and a 275-MW unit for Australia. Delivery of the West Thurrock third turbine-generator is due for 1964. It will have single-axis, tandem-compound re-heat turbine with a multi-exhaust stage in each of four exhaust flows. Initial steam conditions will be 2,300 lb./sq. in. and 1,050 deg. F. with reheat to 1,050 deg. F. It will exhaust at 1.1 in. Hg. The generator will be hydrogen-cooled with direct water-cooling of the stator winding. The terminal conditions will be 353-MVA, 0.8 p.f., 18.5 kV, three-phase, 50 c/s.

G. & J. Weir Holdings Limited, who presently own 50 per cent. of the issued share capital of Weir-Catton Limited, announce that they have made arrangements to acquire the remaining shares of that company. Weir-Catton Limited is a holding company with two operating subsidiary companies, Catton & Co. Ltd., Leeds, and Weir Foundries Limited, Leeds, who manufacture quality castings in carbon, low alloy and stainless-steels for a wide range of industrial applications.

Boiler Plant at a Scottish Saw-Mill

A SOMEWHAT unusual type of boiler plant was recently installed at the works of Brownlee & Co. Ltd., City Saw Mills, Glasgow. This boiler plant was designed and installed by Marshall & Anderson Limited, engineers and boilermakers, Motherwell. The boiler itself is fitted with a furnace which is designed to burn wood-waste as the main fuel, but it is also fitted with oil-burning equipment and, furthermore, it can, in emergency conditions, use coal as fuel. There is, of course, a large quantity of wood chips, shavings, sawdust and odd pieces of wood to be disposed of from the sawmills, and this waste matter is all used as fuel for the boiler plant. The steam generated is used for process requirements and also for space-heating in the works buildings. The boiler is of the Marshall & Anderson patent "Fleming" type, which has special internal features. It is a vertical multitubular type boiler in which the water is inside the tubes and the gases flow at right-angles across the outer surfaces of the tubes. A re-circulating tube of large diameter connects the top and bottom boiler drums, and thus ensures a rapid flow of the water over all the heating surfaces. These special features are claimed to result in a very efficient and rapid steaming boiler.

The wood shavings and sawdust are conveyed to the boiler house from the various parts of the factory by pneumatic means, through ducting to cyclone separators located at the wood-firing platform. This material is then fed downwards through a mild-steel chute into the boiler furnace which is designed to produce the maximum amount of heat with smokeless combustion, even under varying fuel conditions, i.e., when using either sawdust, pieces of wood, or a mixture of both. The works are situated in a residential area, and thus it is highly important that neither smoke nor sparks be discharged from the chimney. A forced-draught fan supplies the requisite air for combustion, the air being admitted partly under the grate and partly through nozzles which direct the air flow over the fuel-bed. This arrangement ensures efficient and complete combustion within the furnace, and allows for maximum heat absorption in the boiler. The mild-steel chimney is 90 ft. high, and provides sufficient draught to allow for the boiler to be operated under natural draught conditions up to about 50 per cent. of the maximum rated output. The oil-burning equipment, which was supplied by Laidlaw Drew Limited, Edinburgh, is of the automatic flame-modulating type, with a full set of safety devices and alarm signals for this



Diagrammatic arrangement of "Fleming" type boiler plant for burning wood-waste, shavings and saw-dust at a Scottish saw mills.

type of equipment. Under normal conditions, the use of wood-waste as fuel is sufficient to allow the boiler to fulfil all space-heating requirements—the oil-burning equipment being used on special occasions and in an emergency, or on occasions when there may be a shortage of wood-waste. The

instruments and control equipment are located on a platform covering the furnace and extending around the boiler. Connection is made between this platform and the wood-firing platform by means of a ladder, and thus easy access is provided around the plant to meet all conditions of firing. It will be appreciated that the burning of these waste products in order to provide the heating requirements at the works, results in a considerable saving in the cost of conventional fuel, as well as providing easy means of disposal of the large amounts of these waste materials. The outline arrangement reproduced herewith shows the general layout of the plant. The "Fleming" boiler is of all-welded construction to Lloyds Class I requirements, and is adaptable for coal, oil or exhaust-gas firing under either manual or automatic conditions. The unit is also extremely suitable for marine installations in view of its light weight, and the small amount of space occupied. The boiler has a high margin of resiliency—it can be operated at 10 per cent. overload for extended periods, and up to 25 per cent. for reasonable periods.

Furthermore, it has an extremely rapid response to fluctuating loads over a wide range. No extra space is required for tube withdrawal when replacements are necessary, as the tubes themselves are withdrawn into the boiler steam space. The U-ring form of construction facilities cleaning and sludge removal at the lowest part of the boiler. Standard stoker-fired "Fleming" vertical boilers are designed for evaporative capacities ranging from 1,740 to 9,540 lb./hr.—the dimensions of this range of unit being from 4 ft. 6 in. dia. by 10 ft. high, to 7 ft. 6 in. dia. by 15 ft. 6 in. high. The range of oil-fired units has evaporative capacities from 1,740 to 11,450 lb./hr.—the dimensions of this range being from 4 ft. 6 in. to 7 ft. 6 in. dia. and from 10 ft. 0 in. to 17 ft. 6 in. high.

Flow Conditions in Boiler Tubes

IN an article, published in the August, 1959, issue of this journal, we described, following a visit to Cambridge, the research being carried out by the Department of Engineering in the University of Cambridge, into the fundamentals of circulation theory in high-pressure boilers and certain other types of evaporative heat-exchangers. As stated previously this research is sponsored by the Water-Tube Boilermakers' Association (8, Waterloo Place, London, S.W.1).

A report on an extensive series of experimental investigations of the fundamental factors influencing the circulation process in high-pressure boilers is now available, and was presented at a meeting of the Institution of Mechanical Engineers in London recently. The report was in the form of a paper by R. W. Haywood, M.A., B.Sc.(Eng.), Wh.Sc., A.M.I.Mech.E.; G. A. Knights, M.A., Ph.D.; G. E. Middleton, M.A., M.I.Mech.E.; and J. R. S. Thom, B.Sc.(Eng.), Ph.D., A.M.I.Mech.E.

The paper was presented in three parts, the first dealing with the high-pressure experimental plant and its associated instrumentation, which was installed on the site of a disused aircraft factory on the outskirts of Cambridge. The installation comprises a closed-circuit test loop, fabricated from mild steel, through which water is drawn, and circulated by a glandless submersible pump. This circuit includes a metering orifice and a throttle-valve to give adjustment of the flow-rate. Before passing through the test-section of the circuit, the water is brought exactly to its local saturation temperature at the inlet to the test section, by means of an electrical preheater. Provision is made for test sections of $\frac{1}{2}$ in., 1 in., and $1\frac{1}{2}$ in. bore, all having a wall thickness of $\frac{3}{8}$ in., to be installed in any of four angular positions; however, the paper describes only those tests on 1 in. and $1\frac{1}{2}$ in. bore pipes in horizontal and vertical positions. The test section is electrically heated by means of mains-frequency induction heaters.

The research work required the development of special differential manometers and differential thermocouples suitable for the accurate measurement of small pressure and temperature differences at high fluid pressures. Gamma-ray absorption equipment is used to measure the mean density of the fluid contained at any instant within a cross-section of the pipe at the test-section outlet, referred to in the paper as the "apparent density," from which could be obtained the relative or "slip" velocity between the two phases.

The second part of the paper deals with the analysis of flow-conditions from measurements of gamma-ray absorption. The results of tests on the $1\frac{1}{2}$ in. bore pipe, in the vertical position, are examined first. In these tests, the tube cross-section was scanned by a narrow pencil of rays from a collimated beam, and scintillation-counter equipment was used to measure the intensity of the emergent radiation. Preliminary tests involving scans along a number of chords of the tube cross-section indicated that the density distribution of the fluid within the cross-section varied with horizontal and vertical pipes. Data obtained from these tests enabled the main series of tests, during which pressure drop readings were also taken, to be carried out with a single scan along the tube centre-line only. From the readings taken during the latter tests, the area dryness-fraction (void fraction), and slip velocity-ratio were calculated and correlated as functions of the mass dryness-fraction. The paper then gives a brief description of the less satisfactory results obtained by tests on the 1-in. bore pipe. The tests on the 1-in. bore pipe were carried out before those on the $1\frac{1}{2}$-in. bore pipe, and at a time when the scintillation-counter equipment had not been developed. An ionisation chamber was used as detector and the lower sensitivity necessitated the use of an uncollimated beam.

Part III of the paper presents an analysis of the pressure-drop measurements made on both the 1-in. and $1\frac{1}{2}$-in. bore pipes, in the vertical and horizontal positions, with particular reference to the frictional pressure-drops in the horizontal pipes, and to comparisons between the experimental results, the values predicted according to the homogeneous theory, and the values predicted after correction for the effects of slip, according to the methods outlined in the second part of the paper. In their conclusions, the authors state that, over the range of variables covered in the tests the experimental pressure-drops at 2,100 lb./sq. in. abs. are close to the values predicted by homogeneous theory for both horizontal and vertical

pipes. For horizontal pipes at the lower pressures, homogeneous theory gives clearer prediction of the pressure-drop for heated than for unheated pipes, owing to the effects of two-phase flow conditions on the frictional and acceleration pressure-drops in the heated pipes. For vertical pipes at the lower pressures, the experimental pressure-drops are significantly greater than the values predicted by homogeneous theory. The gravitational contribution to the total pressure-drop is dominant, and is significantly influenced by the effects of slip. Closer prediction is achieved by introduction of the slip correction-factor presented in Part II of the paper.

The experiments have provided extensive data on the pressure-drop of steam-water mixtures at high pressures, and have illustrated the limitations of homogeneous theory in estimating two-phase pressure-drops. The work has also provided new data on the void fractions of two-phase mixtures and on the effects of slip. There would, however, have been much scope for further experimentation had it not been necessary to bring the work to a close when the site on whch the plant was erected had to be relinquished.

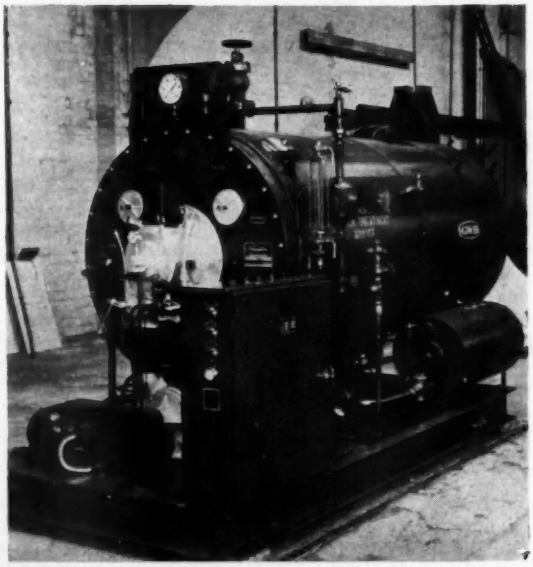
The " Powermaster " Packaged-type Boiler

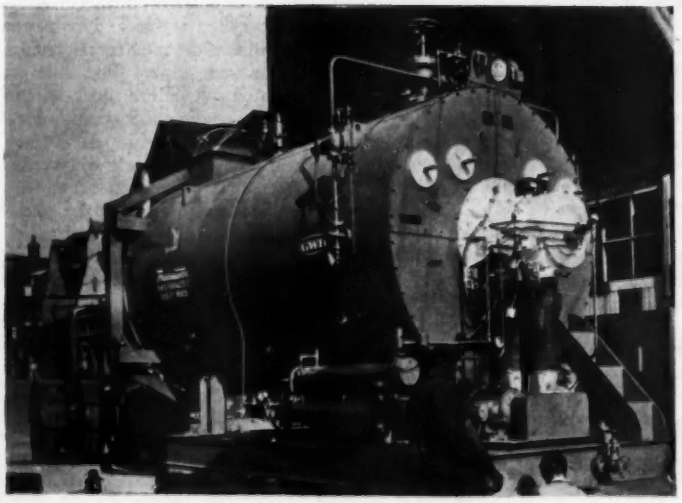
The thousandth " Powermaster " packaged-type boiler to be sold in this country by G.W.B. Furnaces Limited, Dudley, Worcestershire, is at present being installed at the Grimsby Works of Birds Eye Limited. This boiler is the eighth " Powermaster " boiler purchased by Birds Eye Limited, and a further unit is at present on order. The boiler being installed, which is a " model 400," has a guaranteed thermal efficiency of 83 per cent. and an evaporative capacity of 13,800 lb./hr. from and at 212 deg. F. It is 19 ft. 3 in. long by 9 ft. 0 in. wide and 13 ft. 6 in. high, is oil-fired, and weighs approximately 18 tons.

G.W.B. Furnaces Limited built their first " Powermaster " packaged-type boiler in 1954, and this was seen by the British public for the first time at that year's British Industries Fair. Since that time, this type of boiler has been installed by many companies engaged in a wide variety of industrial, commercial and agricultural interests. Recently G.W.B. Furnaces Limited have supplied the boilers for what is claimed to be the largest single packaged-type boiler installation in this country, at the Hereford works of Henry Wiggin and Co. Ltd., where five " Powermaster model 600 " units supply the company's entire space heating requirements. The combined total output of these five units is 105,000 lb./hr. of steam.

The packaged-type boiler has appeared in this country only during the past decade. For some years prior to its introduction in Great Britain, surprisingly little development had taken place in the technique of raising steam for industrial purposes. Up until a few years ago, if a boiler was required, having an output in the range 500 to 24,000 lb./hr. of steam, the most common practice was to purchase a shell and mountings from the boiler maker, while the remainder of the equipment very often had to be purchased from other sources and fitted by the purchasers; this would include such items as feed-pumps, water-level controls, stokers and other ancillaries necessary for a complete unit. In addition, installation costs were not inconsiderable.

American influence can be traced in the evolution of the packaged type boiler. Fire-tube and water-tube units were in quantity production there in 1947, and it was not until after 1950 that a few were made in Great Britain. Since then, the idea of making a boiler a standardised works-assembled unit, mounted on a rigid base with all its auxiliary equipment, has somewhat revolutionised the conception of steam-generation in the applicable range. About 1950, the American company of Orr & Sembower Inc. introduced the " Powermaster," and this, for the first time incorporated the " Voriflow " medium air-pressure burner, which is claimed to be one of the finest heavy-fuel burners in the world. Its inclusion in a packaged-type boiler was proved to be successful. G.W.B.'s association with Orr & Sembower began in 1953 when a licence agreement was arranged. The Dudley company built their first packaged boiler in less than four weeks, in order to have





(Above). The first " Powermaster " packaged-type boiler ready for dispatch from the works of G.W.B. Furnaces Ltd. in 1954.

(Left). A " Powermaster " unit similar to the thousandth boiler of this type, which is to be installed at the Grimsby works of Birds Eye Limited.

it on show at the British Industries Fair in 1954. Other features have also contributed to the " Powermaster's " success. The automatic and safety controls fitted as standard on every unit have been successful, both in the degree of remote-control provided, and in the standard of reliability attained. This equipment is designed and manufactured by the Control Gear Division of G.W.B. Furnaces Limited, at Dibdale Works, Dudley. One of the main advantages of the packaged-type boiler is the ability to give each unit a thorough trial under specified conditions of feedwater and fuel in the works. Another advantage is that on a packaged-type boiler all the ancillary equipment is the responsibility of one supplier.

The " Powermaster " is similar to its American counterpart. The chief difference is that, in order to comply with British standards and insurance companies' recommendations, some of the scantlings had to be increased, thus the G.W.B. " Powermaster " is somewhat heavier. Larger units have been added to the range, which now comprises 17 models with outputs of from 517 to 24,000 lb./hr. of steam. Each unit can be arranged to deliver steam at pressures up to 250 lb./sq. in.; or supplied as low, medium or high-pressure hot-water boilers, either flooded or with steam space. Suitable fuel-oils range from diesel oil up to viscosities of 3,500 secs. Redwood No. 1 in all but the smallest sizes; town's gas may also be used, or an oil/gas combination. The change-over from one fuel to another can be simply made.

AUTOMATIC CONTROL FOR BABCOCK BOILER AT WEST THURROCK

In the March, 1961, issue of this journal, we published details of a new electronic computer for industrial applications, with particular reference to the fact that such a computer is to be provided for use in connection with the control of the Babcock 1,400,000 lb./hr. boiler steaming a 200-MW turbo-alternator set (No. 2 unit) at West Thurrock power station.

The unusually comprehensive system of instrumentation and control for the West Thurrock plant is being supplied by Evershed & Vignoles Limited, from whom we have received further information concerning the equipment being supplied.

This is the first British power station in which the whole of the boiler/turbine unit is included in a main overall control loop. This loop relates the electrical output of the plant (in megawatts) as a significant control criterion, to the fuel input to the boilers. Such a control scheme represents an important advance over existing automatic control schemes in which generally, the main control criterion was the heat output to the boiler in relationship to the fuel input. In the control scheme developed for West Thurrock, a measurement transducer, sensitive to the power station load, will generate a signal proportional to the load, which forms the main input variable to three " on-line " analogue computers, each of which additionally receives one input signal representing (a) master pressure, (b) air/steam ratio, and (c) furnace pressure, respectively. The computers process the signals continuously and instantaneously according to pre-determined formulae, and their output signals, after passing through subsequent stages of the control loop, regulate the operation of the mills and of the forced-draught and induced-draught fans. The signal representing the power station output is thus automatically trimmed by other significant parameters as required in various sections of the installation.

In general, the control scheme may be sub-divided into nine main control sections, but a number of subsidiary control loops are provided additionally.

(1) Master and mill load controls.
(2) Mill temperature controls.
(3) Steam temperature controls.
(4) Furnace pressure controls.
(5) Air/steam ratio controls.
(6) Drum control and feed-flow controls.
(7) Cold side air-heater controls.
(8) Wind-box pressure controls.
(9) Cooling-air controls.

The analogue automatic instrumentation and control equipment which Evershed and Vignoles Limited are supplying and which consists mainly of standard units from the Evershed range, is based on transmitters for numerous types of physical variables which operate on the Evershed Electronic Repeater System, Mark 4, three-term process controllers, simple analogue " on-line " computers, and electro-hydraulic positioners. Apart from the plant-mounted transmitters and the electro-hydraulic positioners, the control equipment will be contained in a central control room, with extensive indication and recording facilities provided to display the operation of the various loops. Amongst a number of miscellaneous and auxiliary instruments, the " in-line " scanners are of particular importance as they facilitate the supervision of numerous plant parameters by a single operator. Withdrawable printed circuit boards and standard electronic sub-units are widely used, and in conjunction with advanced auto/manual switching facilities will permit routine supervision and servicing of the equipment without interference with the station operation. Automatically-initiated alarm facilities in the appropriate control circuits safeguard all important sections of the plant.

An interesting feature of the system is the provision of a Ferranti " ARGUS " digital process control computer which will carry out the overall automatic control of the unit during start-up and shut-down of the plant, by generating a re-setting signal for the set points of the Evershed analogue process controllers. This has necessitated a number of transmitters of exceptionally wide measurement range, covering, say, from zero to full working-pressure, which, when normal operating conditions are reached, are automatically replaced by transmitters covering the normal working range only, but with extreme sensitivity. Fully-automatic operation of the station is thus achieved throughout. Once the station load and boiler operation have reached normal level, the control is effected continuously by the three-term process controllers.

The General Electric Co. Ltd. and **Richardsons Westgarth & Co. Ltd.** recently announced that they have decided to pool their resources for the design, development, sales and manufacture of heavy electrical power generating and industrial power plant. The object of this arrangement is to secure an increase in their share of home and export markets, and at the same time to make the maximum possible use of the combined technical resources and production facilities of the two companies. The manufacture of all the plant concerned (steam turbines, turbo-alternators, blowers, compressors and exhausters) will be shared and initially based on current G.E.C. designs. Richardsons Westgarth will concentrate on the design for industrial power plant, with the object of supplementing existing G.E.C. designs, and widening the range of plant offered. Richardsons Westgarth will also continue to be responsible for the sales and manufacture of condensing and feed heating plant, rotary water strainers, evaporators and shell type boilers to its own design, and land-type water tube boilers to Foster Wheeler design, as well as its wide range of modern engineering activities. The two companies, therefore, are now jointly in a position to build and equip (both electrically and mechanically) complete modern power station plant within their own resources.

The Central Electricity Generating Board announce that they are to place contracts for plant for their Tilbury " B " power station with the **Foster Wheeler-John Brown Land Boilers** consortium for four 350-MW boilers, and with **Richardsons Westgarth (Hartlepool) Limited** for four sets of steam condensers and feed-heating plant. Each boiler will deliver 2,450,000 lb./hr. of steam to the turbines, which will have stop-valve steam conditions of 2,300 lb./sq. in. at 1,050 deg. F. with reheat to 1,050 deg. F. The four turbo-alternator sets are to be supplied by **G.E.C. Limited**—the first two machines being scheduled for commissioning in 1965, and the remaining two in 1966.

Mr. H. McNeil, B.E., M.I.Mech.E., M.I.E.E. (managing director, Babcock & Wilcox Limited) has been appointed chairman of the Water Tube Boilermakers' Association in succession to **Mr. J. B. Woodeson,** O.B.E. (chairman, Clarke, Chapman & Co. Ltd.) who completed, on May 4th, 1961, a period of four years as the Association chairman. **Mr. C. J. Howard** (managing director, John Thompson Water-Tube Boilers Limited) has been re-appointed vice-chairman of the Association, a position he has held since the retirement in September, 1960, of **Mr. W. Messer** (International Combustion Limited).

RECENT Equipment AND Accessories

English Electric gas-turbine at Fawley

The EM27 gas-turbine plant installed by The English Electric Company at the Esso Petroleum Company's Fawley Refinery, Hants, is said to be providing additional evidence of the inherent reliability and very low maintenance requirements of the company's industrial gas-turbine machinery. In the plant at Fawley the EM27 turbine is directly-coupled to a Clark multi-stage gas-compressor which handles propylene; this gas is employed as a refrigerant on a process plant making butadiene, which is one of the chemicals used in the manufacture of synthetic rubber. The turbine is fuelled by refinery gases and a waste-heat boiler in the turbine's exhaust system recovers sufficient heat to raise 18,000 lb./hr. of steam at 125 lb./sq. in. Overall efficiency of the turbine-boiler combination at full load is more than 60 per cent. The turbine has completed some 17,000 hours' operation in just over two years of commercial service; loads have varied from about 75 per cent. to over 100 per cent. of rated capacity. Details of running experience up to September 9th last year show that, in the total running time of 13,761 hours at that date, the gas-turbine had only been out of commission for about 38 hours, due to faults. This represents an availability factor of 99 per cent. The details also show that the turbine had then run for 13,761 hours out of a possible total of 15,596 hours. In other words it had then been in operation for 88 per cent. of the available time since it was commissioned. The longest non-stop run was 4,111 hours, or approximately six months. The faults which necessitated the 38 hours down-time were: failure to start through a defective contact in the ignition system, the turbine being tripped by a faulty instrument in the high exhaust-temperature protection system; this particular instrument has since been modified to eliminate recurrence of the trouble. After the turbine had been in service for some 14 months and had accumulated 9,200 running hours the complete petro-chemical process plant was shut down for its first major inspection and overhaul. The opportunity was then taken of dismantling the turbine to examine the component parts. The machine was found to be in excellent condition throughout and remedial work was confined to cleaning the compressor blades. The engine was re-built with its original components (including burners and combustion-chamber flame tubes) and replacements were confined to such minor items as gaskets, seal rings, etc. The Esso Petroleum Company decided at an early stage to provide no standby for the gas-turbine despite the fact that a turbine shut-down would virtually stop the production of butadiene. The performance of the EM27 is claimed to have justified this decision. (*The English Electric Co. Ltd., English Electric House, Strand, W.C.2.*)

New range of unit contactors

Dewhurst and Partner Limited have recently introduced a completely new range of unit contactors. Known as the "H" series these contactors (Fig. 1) are available in 50, 100, and 200 A versions for a.c. or d.c. working. Each version may be supplied as a single or multi-pole unit. The construction allows additional poles to be added (within each version) to a single-pole unit, without the need for changing the coil. The

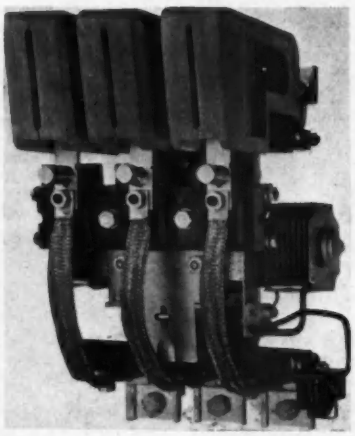


Fig. 1. "H" series unit contactors. (Dewhurst & Partner Limited.)

unit mounting and front wiring of these contactors are claimed to facilitate installation and maintenance, as is the single-screw fixing of the coil and contacts. All units are said to be exceptionally quiet in operation, making them ideal for applications where noise must be kept to a minimum. Rated to B.S.S. 775 (A4 or D4) and having full C.S.A. approval, they are short-circuit tested at 31-MVA, against their respective B.R.C. fuse ratings. A unique blowout system incorporating separate tungsten arcing contacts is claimed to obviate derating and to ensure very long operating life. Extras available include auxiliary contact assemblies, and damp and dust-protecting, or weatherproof case. Intended for extra-heavy duty in any climatic conditions, these units are fully described in technical publications Nos. PD400-10/11 available, on request, from the manufacturers. (*Dewhurst & Partner Limited, Inverness Works, Hounslow, Middlesex.*)

New Airetool tube-expander

A long-standing problem of rolling small tubes rapidly and accurately is claimed to have been solved by The Airetool Manufacturing Company, with the introduction of its new "Model 400-TR" tube-expander. This pneumatic motor tool has been specially-designed for expanding both ferrous and non-ferrous tubes from $\frac{1}{4}$ in. to $\frac{3}{8}$ in. Weighing only $2\frac{3}{4}$ lb., the motor is held by hand and run constantly with trigger control for instant forward and reverse operation, giving the operator control at all times. The special size condenser and heat-exchanger tube-expanders developed for these small tubes are said to produce a smooth, unridged surface in the tube. They give exceptionally long service, and feature a ball-bearing thrust collar which eliminates frictional heat. The rolls are tapered to produce uniform expansion and tightness throughout the tube-sheet. (*The Airetool Manufacturing Company, Springfield, Ohio, U.S.A.*)

New portable oxygen analyser

Servomex Controls Limited, who manufacture the Distillers Company's industrial oxygen analyser, have developed a portable instrument utilising the same magnetic-susceptibility measuring cell. Among many other industries, there is said to be a need for this instrument in gas-works, steelworks, boiler houses, chemical plants, refineries, brewing and fermentation processes, dyeing and general research work. The type "DCL 101" portable analyser (Fig. 2) is a battery-operated device, which can be regarded as an alternative to the Orsat apparatus for determination of oxygen anywhere in the range 0-100 per cent., to an accuracy of plus or minus 0.1 per cent.

Operation is simple, and as the device is linear, calibration at two points is sufficient to standardise over the whole scale. The zero is claimed to be highly stable, and a check of the span, using air as a test gas, is sufficient for most normal uses. The analyser may be used with static samples or with a continuously flowing sample, which must be filtered

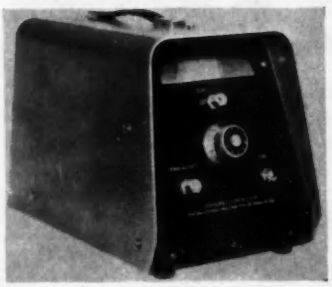


Fig. 2. Type "DCL 101" portable oxygen analyser. (Servomex Controls Limited.)

and cooled sufficiently to remove condensate. The DCL measuring cell contains a very light dumb-bell-shaped test body suspended by a platinum ribbon in a non-uniform field. The torque on the test body, produced by the presence of oxygen in the measuring cell, is balanced by passing current through a coil wound on the dumb-bell. The balance condition is observed by means of a light spot reflected on to a scale, and is obtained by adjusting a calibrated source potentiometer. The read-out is taken direct from a linearly-calibrated ten-turn dial. The DCL 101 portable oxygen analyser is 13 in. long, by 8½ in. wide by 9½ in. high and weighs 18 lb. (*Servomex Controls Limited, Chemical Instrument Division, Crowborough, Sussex.*)

"Evis" fluid (water and fuel-oil) conditioners

The recently introduced "Evis" water conditioner precipitates hardness, which, in its untreated form, leads to scale formation in boilers and water systems. It is an entirely self-contained unit of aluminium alloy which, it is claimed, by its structure alone, induces physical—not chemical—changes in the water, so that not only is scale formation inhibited, but old scale is reduced to a soft sludge which can be eliminated through the normal blow-down process. The manufacturers state that its effectiveness and efficiency have been proved in steamships. Adoption of the "Evis" water conditioner does not involve interruption of supplies as it is secured to the exterior of the previously cleaned service pipe. The "Evis" fuel-oil conditioner operates to overcome circumstances which stem from the fact that fuel-oils comprise several kinds and weights of oils, all of which contain, in varying quantities, wet gases, petrol fractions, kerosene, heavier mineral-oils, wax, asphalt, and sludge. These components have a tendency to form small homogeneous masses, and some of them, by their very nature, will not be burnt but will be deposited as black, spongy residues which will be charred into oily soot. These oily soot particles will continue to be subjected to the burning process which will eliminate their surface carbon and leave oil-filled mineral slag incrustations which are difficult to prevent or remove. The "Evis" manufactured entirely in bronze, overcomes this massing of like particles and is claimed to result in better combustion with higher CO_2; clean burner nozzles; clean firesides, tubes and flues; longer life for refractories, and increased efficiency. The conditioners are made in sizes to fit all installations. (*Charles A. Worth, 149, Station Road, Sidcup, Kent.*)

Low conductivity electromagnetic flowmeter

Fischer and Porter have recently developed a low-conductivity electromagnetic flowmeter system which is said to considerably extend the range

Fig. 3. Low conductivity electromagnetic flowmeter. (Fischer & Porter Limited.)

of applications on which this type of flowmeter may be used. Hitherto, it has been impossible to use magnetic flowmeters for handling fluids with a conductivity of less than 20 microhms/cm., but with the introduction of certain design changes, Fischer & Porter have produced a magnetic flowmeter system which, it is claimed, will handle liquids and slurries having a conductivity as low as 0.1 microhms/cm. This means that the rate of flow of fluids not far removed from pure hydro-carbons can now be accurately determined by this magnetic meter. The electromagnetic flowmeter (Fig. 3) is claimed to be obstructionless, accurate, bi-directional, and unaffected by changes in viscosity or density. (*Fischer & Porter Limited, Workington, Cumberland.*)

Rototherm spring clip modification

A time-saving modification for users of their bi-metal horizontal and vertical-pattern industrial thermometers has been introduced by The British Rototherm Co. Ltd. The modification (Fig. 4) consists of a strong, adjustable steel spring-clip secured on the base of the instrument.

Fig. 4. Rototherm spring clip modification. (The British Rototherm Co. Ltd.)

The clip firmly grips the body-nut, and is said to eliminate entirely the gland and gland-nut, and the need for the use of a spanner. The modification is available for use with or without separable pockets. It is claimed to greatly facilitate the fitting or removal of the thermometer. For heating and similar liquid installations where the pocket is fitted permanently, the clip enables the instrument to be quickly attached or removed without draining the system. The clip modification is available for instruments in all standard temperature ranges in 2½ in. and 4 in. dial sizes. (*The British Rototherm Co. Ltd., Merton Abbey, London, S.W.19.*)

New bridge motor controller

A new adjustable-speed drive, which has been rationalised to provide a wide range of alternative ratings and control characteristics, is announced by Lancashire Dynamo Electronic Products Limited—a member of the Metal Industries Group. This Series BMC.1 drive is supplied complete with motor and remote-mounting control station for finger-tip speed-adjustment. In ratings from 1 to 3½ h.p., and having a speed control range of 10 : 1, the equipment is said to ensure good regulation of motor speed in the presence of fluctuating loads. Optional features include reversing and dynamic braking, and on all models, full protection against overload of the motor and control equipment is ensured by built-in current-limit protection. The

in condensate systems

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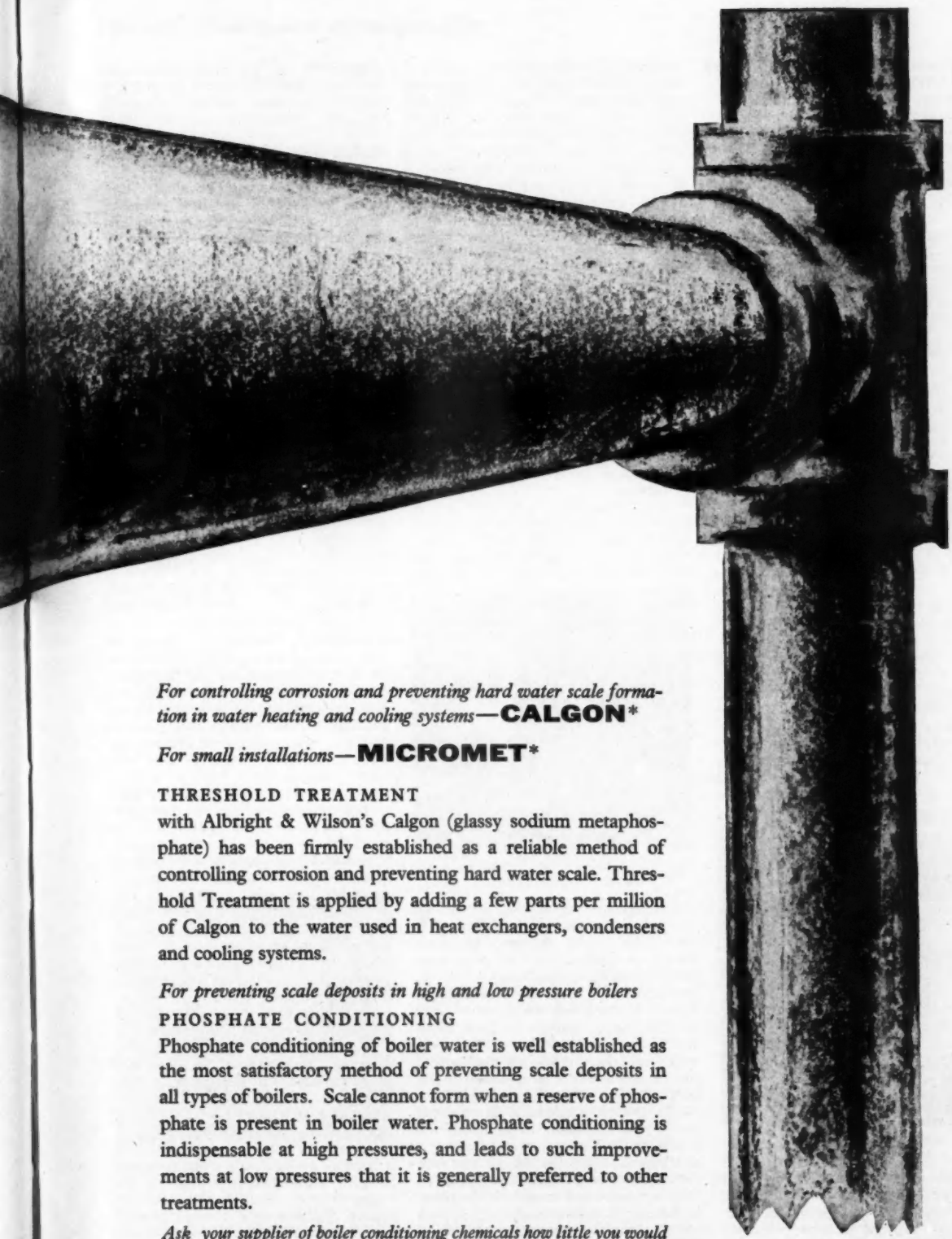

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equipment is contained in a fabricated case, and is intended for wall-mounting. Motors are available having various enclosures and a wide range of base speeds, and can also be supplied complete with gear-heads where required. (*Lancashire Dynamo Electronic Products Limited, Rugeley, Staffs.*)

Condensed steam recovery at new Rolls-Royce factory

Considerable savings in heat, water and labour are being made, it is claimed, in the new factory of the Aero Division of Rolls-Royce Limited, at Derby, by the use of four condensate-recovery units. The units return condensed steam to the boiler-house after it has done its heating work, thus providing a saving of heat which would otherwise be rejected into a drain. Because the condensate is re-circulated, the necessity of bringing in fresh water continuously from the main is avoided. A further advantage lies in the fact that the water does not require continual chemical treatment before use. When the water is first brought in from the main it is treated to prevent scaling in the boilers. Subsequently, because it is continually re-used, no further treatment is required. This results in economies in the chemical needed for treating the water, and also in the number of personnel necessary to conduct the operation. The condensate-recovery units, manufactured and supplied by Girdlestone Pumps Limited, are an integral part of the heating and air-conditioning system. When this system is not operating in summer months, the

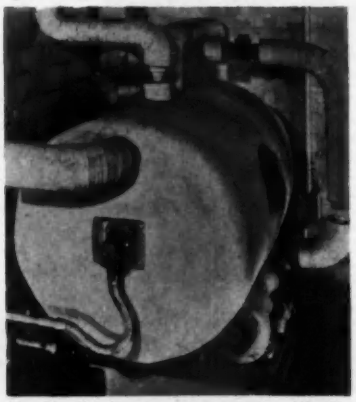


Fig. 5. Condensate recovery unit. (Girdlestone Pumps Limited.)

units are used in conjunction with steam-heated process equipment. The units, which are compact and self-contained (Fig. 5), comprise a receiving tank and a motor-driven centrifugal pump mounted together on a substantial fabricated-steel base, and are complete with pipe connections and gate-valve between tank and pump, non-return valve on delivery connection, magnetic level-switch and starter. In the Rolls-Royce factory the units are insulated with mineral-fibre insulation to keep the condensate at an approximate temperature of 170 deg. F. This results in more heat being returned to the boiler-house plant and, therefore, less fuel being required to raise steam in the boilers. The installation by Rolls-Royce Limited of these condensate-recovery units in their new factory, in which are manufactured fuel elements for reactors for use in nuclear-powered submarines, follows the successful operation of similar units in many of the company's other factories. (*Girdlestone Pumps Limited, Woodbridge, Suffolk.*)

Light-duty gear unit for Audco valves

A new light-duty gear unit (Fig. 6) has been produced for use with certain wrench-operated Audco valves. The unit has been so designed that it may easily be fitted to existing

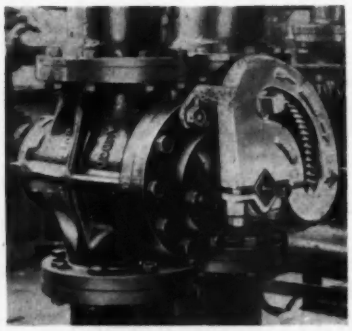


Fig. 6. Light-duty gear unit for Audco valves. (Audco Limited.)

valves already in service, or it can be supplied fitted to a new valve. This unit has a cast-iron quadrant which is clamped to the plug-stem of the valve. Meshing with the quadrant is an Audcoloy pinion which is mounted on a stub shaft attached to the valve. Internal teeth have been used, both to give correct rotation of the valve, clockwise closing, and also to afford protection to the gear and operator. No lubrication is said to be needed on the gear, a better performance being obtained when dry. This new equipment is not intended for use as a substitute for existing worm-gear units, but to offer a mechanical means of operating certain larger wrench-operated Audco valves with a minimum of effort. A new brochure (Publication No. 609), which is obtainable from the manufacturers, gives details of this unit, and lists the valves to which it may be applied. (*Audco Limited, Newport, Shropshire.*)

A.E.I. control system for oil-fired heating boilers

The sequencing control unit (Fig. 7) used in the new range of Wilson oil-fired boilers is supplied by the Instrumentation Division of

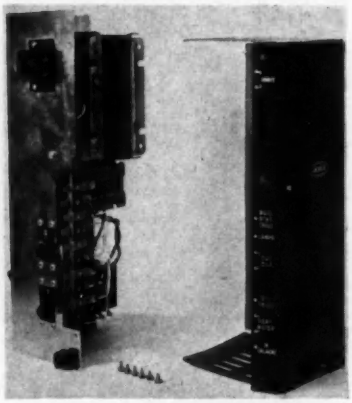


Fig. 7. Sequencing control unit for oil-fired heating boilers. (Associated Electrical Industries Limited.)

Associated Electrical Industries Limited. Unlike the type of burner in which a pilot-light burns continuously, the system now preferred requires that the flame be completely extinguished between heating periods, and the sequencing unit, which has been designed in conjunction with Henry Wilson & Co. Ltd., Liverpool, therefore not only controls fuel supply to the burner, but also initiates ignition. Production of domestic boiler controls by A.E.I. Instrumentation Division is the logical development from extensive experience in domestic appliance temperature controls. The Division already manufactures "Sunvic" room, convector and water-heater thermostats and also time-delay switches. (*A.E.I. Limited, Instrumentation Division, Crown House, Aldwych, London, W.C.2.*)

"Eel" recording flue-dust monitor

Evans Electroselenium Limited have recently introduced their new "Eel" recording flue-dust monitor. This apparatus is designed to record automatically the emission of harmful dust, grit and oil particles from industrial boiler-house chimneys, and to give immediate warning, to the engineer-in-charge, of the offensive nature of the smoke plume before it leaves the chimney. Not only is this photo-electric apparatus claimed to prevent damage and offence to sur-

rounding property, but also gives warning of the inefficiency of solid-fuel pulverisation, dust-collecting plant, oil-firing apparatus and the fuel in question. The "Eel" recording flue-dust monitor comprises a sampling and measuring head, a control unit and a recorder unit. The sampling and measuring head is fitted to a duct leading to the chimney, and samples the percentage of dust and grit photoelectrically (with progressive emphasis from 20 microns upwards), at pre-determined intervals, usually of 15 min. If the dust burden reaches offensive proportions the signals passed to the control unit will automatically actuate an alarm system. Should the burden become so great as to be incapable of being recorded at normal set intervals, the instrument automatically records more frequently. The recorder unit provides pen readings graphically on a 24-hour chart, which presents these readings in units of percentage obscuration/minute relative to a vertical surface exposed to the dust. This new technique is said to offer advantages over other systems in that it detects grit and oil smuts, which would be undetected until complaints had been received from outside sources. The "Eel" recording flue-dust monitor has been developed in conjunction with the Central Electricity Research Laboratories and has applications in power stations, chemical and oil plants, brick and cement works, and many other industries. (*Evans Electroselenium Limited, St. Andrew's Works, Halstead, Essex.*)

"Industrion" electrical air-filters

The Trion electronic air-filter, marketed for industrial applications by W. C. Holmes & Co. Ltd. since 1956, has been redesigned to meet

Fig. 8. Collecting cell of "Industrion" electrical air-filters. (W. C. Holmes & Co. Ltd.)

the arduous operating conditions encountered in industry, and it will in future be known as the "Industrion" electrical air-filter. The new filter is of much sturdier construction than its predecessor, the collecting cell (Fig. 8) being fabricated from a heavier-gauge aluminium, and the supporting framework and ionising section support-bar have been strengthened. Another advantage is that the insulators are now positioned out of the main air stream; this facilitates cleaning and ensures greater reliability. The associated electrical equipment has also been improved, and there are now two standard sizes of power units which, in various combinations, are claimed to meet the power requirements of individual installations. A further development is the introduction of a special heavy-duty filter which is intended for use on applications where the dust burden is higher than that handled by the standard filter. With this heavy-duty filter, pre-collectors of the multi-cell cyclone type are normally fitted to arrest any large particles which may be present in the extract system. As opposed to the standard filter which is cleaned by washing, heavy-duty filters are normally arranged for dry removal of the dust, the complete filter section being vibrated to dislodge the collected dust which falls into storage hoppers below the filter. The cleaning operation occupies only a few seconds and the filter can be immediately returned to line. One of the advantages of this system of cleaning is that the filter can be frequently cleaned thus allowing a high dust burden to be handled. The "Industrion" range is completed by the "Industrion" oil-mist precipitator which has been specifically designed for the elimination of oil-mist and smoke emanating from high-speed cutting, grinding, and machining operations. (*W. C. Holmes & Co. Ltd., Turnbridge, Huddersfield.*)

New welding equipment

A new version of the "Comet Series II" CO_2 welding equipment is the "Duomatic" (Fig. 9) designed specifically for the attachment of stiffeners in ship fabrication, etc. A particular feature of the control is that intermittent welding may be used, thus avoiding buckling due to weld contraction. Simultaneous fillet-welds on each side of the stiffener may be continuous or intermittent, as required. The equipment is mounted on two legs, each having a motorised wheel and a parking bracket. In front of the carriage, two inclined wheels engage the stiffener and plate to maintain the welding nozzles in correct alignment to the joint. These components are mounted on tubular arms which enable one nozzle to be set in advance of the other. The drive wheels may be declutched for manoeuvring into position, lifting lugs being fitted for craneage. The machine has been designed to clear stiffeners 20 in. in height, and may be operated from standard d.c. power sources at currents up to 750 amps per wire. Wire sizes of $\frac{1}{8}$ in., 5/32 in. and $\frac{3}{16}$ in.

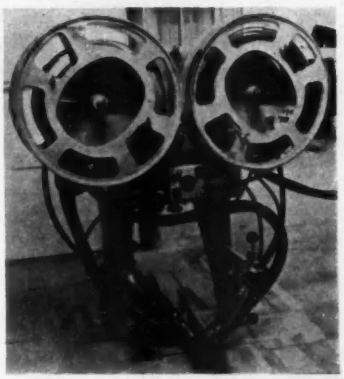


Fig. 9. "Comet Series II" CO_2 welding equipment. (Rockweld Limited.)

can be utilised with welding speeds in the range of 12 to 35 in./min. The unit is robustly constructed for shipyard conditions, and has a total weight of 4 cwt. The Comet process, say the manufacturers, is believed to be the most economical method of semi-automatic welding on all applications for plate thicknesses of $\frac{1}{4}$ in. and above. (*Rockweld Limited, Commerce Way, Croydon, Surrey.*)

Fielden "Bikini" temperature controller

No moving parts are used in a temperature control system employing the Fielden "Bikini" temperature controller and a saturable-core reactor. Many thousands of controllers, which are completely transistorised, have gone into service on plants all over the world during the last three years and the makers claim that it is the most reliable instrument they have ever produced. This reliability is now coupled to that of saturable-core reactors to give temperature control of circuits of up to at least 10-kW with absolutely no maintenance, and an almost indefinite life claimed. The "Bikini" Controller and saturable-core reactor operate from a robust stainless-steel measuring bulb of only $\frac{1}{4}$ in. dia., and two types are available; one for use at temperatures up to 500 deg. C. and the other for temperatures up to 850 deg. C. The controllers are available in 73 ranges covering tem-

Coal sews things up

EMANCIPATION—for women—began just over 100 years ago, when Isaac Merritt Singer invented the first practical sewing machine and released women from one of the oldest domestic chores in history—stitching and sewing by hand. With the turn of a wheel, busy mechanical fingers worked faster, better—and tirelessly. Today, every Singer sewing machine is a compact miracle of sewing skills—but its basic duty remains essentially the same, to the delight of millions of women in every land.

At the vast Singer factory at Clydebank in Scotland, chain grate stokers feed a moving belt

for Singer

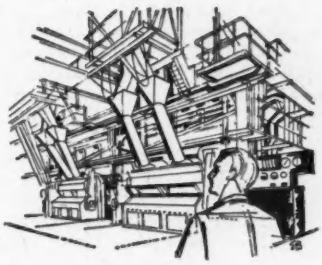
of heat under the 4 giant boilers in the impressive powerhouse. The fuel is coal—chosen by the directors for reasons of convenience, economy and reliability. The choice is a wise one, for coal, mechanically stoked, is smokeless, and produces more heat for the money than any other fuel. Furthermore, the coalfields of Britain can supply all the fuel our industries will need for scores of years to come.

Whether your own industry is big or small—remember Singer. Coal sewed up their fuel problems: the pattern is one you could copy with profit.

PROGRESSIVE INDUSTRY IS GOING FORWARD ON

COAL

ISSUED BY
THE NATIONAL COAL BOARD



Coal generates power at Singer's Clydebank Factory

Mr. C. H. Fielding, Power Station Superintendent, comments:

"At Singer we provide our own power and steam process requirements from coal.

Two large boilers were installed in 1928 and a further two in 1950. Each has a continuous rating of 60,000 lbs. per hour.

The factory also has a large woodworking department, and the considerable quantities of wood chips and sawdust which have to be disposed of are burned in the boiler furnaces along with coal. Coal and ash handling presents no problem here. The boiler fans and the sawdust control equipment are driven by variable speed motors. Control is simple.

The designed efficiency of the boilers and economisers is 84% and they are operated between one annual overhaul and the next with nothing more than the normal maintenance. Their availability is high.

The quality of coal received is always consistent, its properties being regularly checked in the laboratory. Around 48,000 tons of coal and 4,000 tons of wood chips and sawdust are now consumed each year in the boilers.

We at Singer choose coal because it meets all our fuel requirements."

Here are some key facts and figures about the consumption of coal at Singer:

Number of boilers:	4 water tube
Method of firing:	chain grate stokers
Steam Pressure:	360 lbs. per square inch
Continuous max. rating:	60,000 lbs. of steam per hour each
Steam temperature:	725°F.
Feed temperature:	185°F.
Annual fuel consumption:	48,000 tons of coal

perature spans as short as 50 deg. C. and as wide as 600 deg. C. The control differential is only 0.5 deg. C. and if desired the controller can be located as much as 300 ft. away from the measuring point. (*Fielden Electronics Limited, Wythenshawe, Manchester, 22.*)

New electrode for mild steel

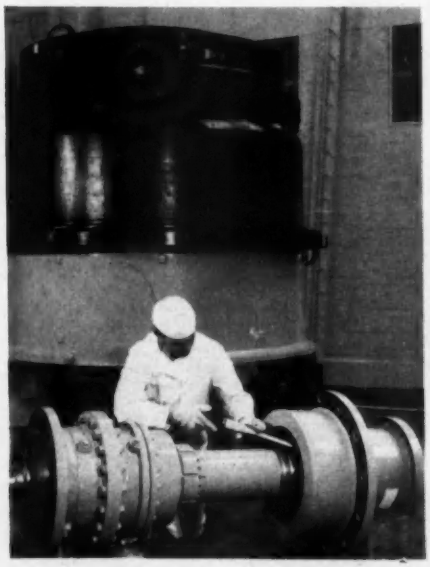
Associated Electrical Industries Limited has recently introduced a new Class E.217 mild-steel welding-electrode, the "Gazelle." The new electrode represents an addition to the range formerly known as Metrovick electrodes (with names Sylvick, Castivick, etc.). The "Gazelle" has been developed to obtain smooth and speedy welding; features of the new electrode, claimed by the manufacturers, are high travel speeds, longer runs per electrode than with standard Class 2 electrodes, and a combination of characteristics that ensure high-quality welds with maximum ease of operation. Of the non-iron-powder, contact type, the "Gazelle" is said to be capable of satisfactory operation over very wide current ranges; for example, the current range for a four-gauge is 190/350 amp. Operation is similar to that of iron-powder contact type electrodes, with an added advantage of negligible spatter. "Gazelle" electrodes are approved by Lloyds and the Ministry of Transport, and are now available for test purposes or for normal demands. (*A.E.I. Limited, Transformer Division, Trafford Park, Manchester.*)

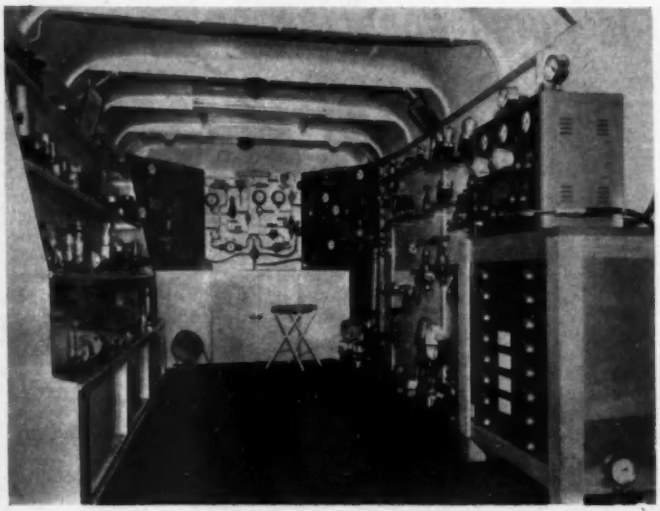
Gas-Circulators for Hunterston Nuclear Station

Manufacture, final cleaning and assembly of the gas-circulator components for the South of Scotland Electricity Board's Hunterston Nuclear Generating Station is carried out by The General Electric Co. Ltd., at its Erith engineering works. The accompanying illustration shows an operator cleaning the thrust-bearing carrying the hollow impeller shaft of one of these circulators. This operation is performed under nuclear-clean conditions, as is the subsequent assembly of the shaft inside the dome casing seen in the background. On top of this dome casing is the impeller, awaiting assembly on its shaft. After assembly and packing, this machine will be taken to the site at Hunterston, ready for installation in the base of one of the eight steam-raising units of the first reactor. When operating, this gas-circulator will handle 710 lb. of carbon dioxide per second, and it will be driven by a 1,230-V, 2,354 h.p., 1,040 r.p.m. double-armature d.c. motor. On one end of the impeller shaft can be seen the Crane gas-seal assembly which has been specially developed to minimise leakage of the carbon dioxide coolant at the point where the shaft penetrates the pressure-shell of the steam-raising unit. The seal will be supplied with oil which will be automatically maintained at a pressure of 1 lb./sq. in. lower than that of the circulating carbon dioxide. When operating, the leakage of carbon-dioxide through the seal will be less than 0.03 lb./hr., and this will be directed to the seal-oil tank which is fitted with a stack to allow the gas to escape to atmosphere.

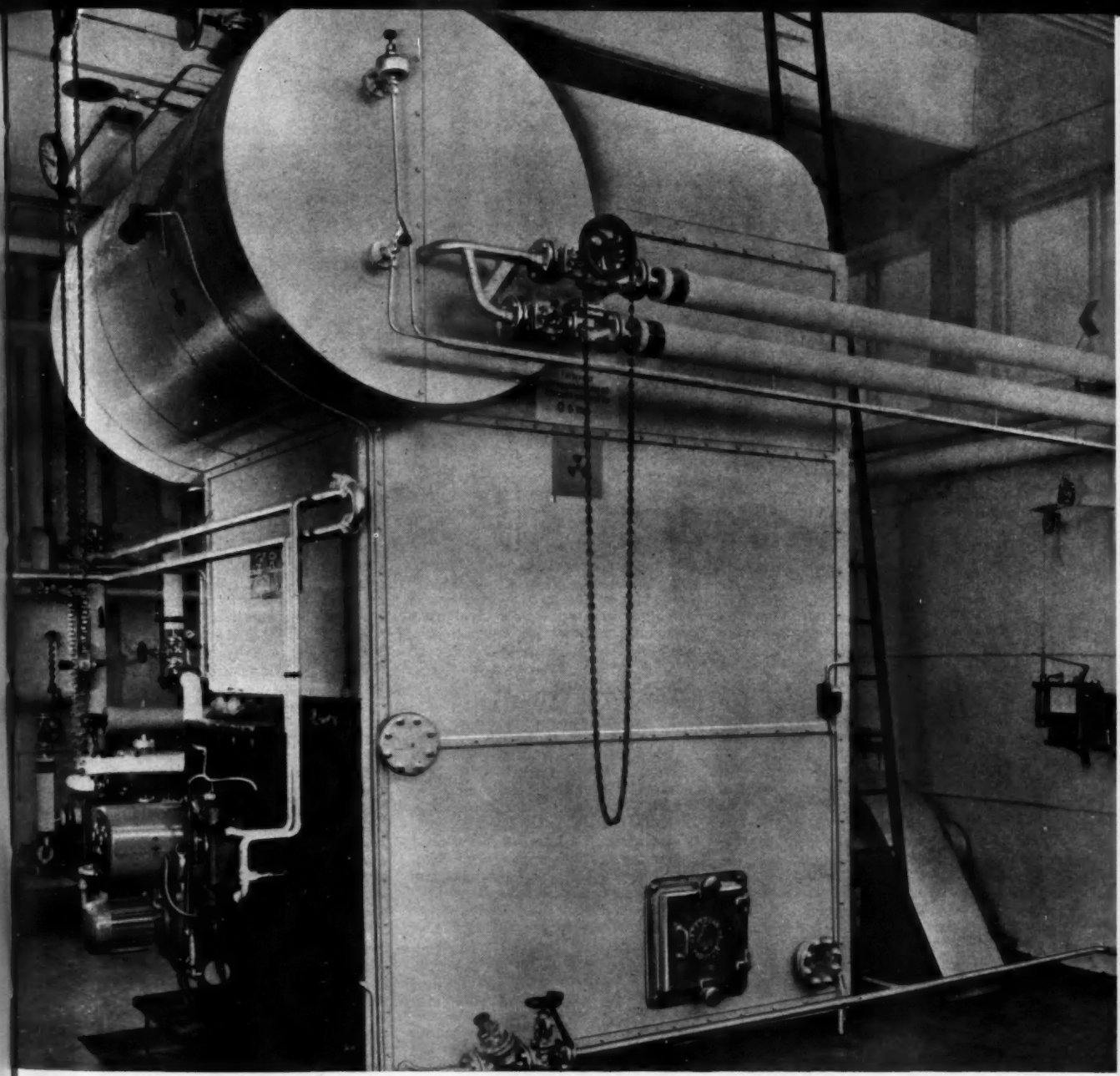
Demonstrations followed by technical discussions on clients' and potential clients' own premises, is the latest sales aid adopted by **I.V. Pressure Controllers Limited,** to bring their wide range of pneumatic and hydraulic valves and components to the attention of engineers in many industries. After operations carried out over two months, the venture is claimed to be an assured success. It has already toured London and the South West, visiting some 60 firms and the company's general sales manager claims that so far they have only "scratched the surface." The response so far has been tremendously encouraging to the firm. By the end of the year, it is estimated that the trailer will have visited between 600 and 700 companies throughout the country, and the demonstrations will have been seen by over 8,000 engineers. It is expected that the unit will be "on the road" for ten months in every year. The trailer, which started life as a British Railways articulated van, was refurbished, and the interior designed to contain a comprehensive exhibit of every valve and component manufactured by the company. It can accommodate up to seven engineers at a time and the demonstration lasts just over half-an-hour. Engineers can not only examine the products but also see them working under pressure on the specially-designed "live" console. The trailer has a staff of three—a driver/demonstrator, technical engineer and the area representative.

Mr. D. G. Sinfield, manager of the welding division of C. A. Parsons & Co. Ltd., has retired after 31 years' service with the company. He was past-chairman of the North-Eastern (Tyneside) Branch of the Institute of Welding, and was branch secretary for ten years.





(Above). Preparing part of one of the Hunterston gas circulators for assembly under nuclear-clean conditions at the Erith works of G.E.C. Limited. (Right). Interior of the mobile display trailer of I.V. Pressure Controllers Limited, which contains their complete range of pneumatic and hydraulic valves and components.



THE REDFYRE CORNER TUBE BOILER
for High Pressure Hot Water and Steam

For the tallest buildings, for hospitals, factories, in fact any building requiring high-pressure steam or hot-water heating, the Redfyre Corner Tube Boiler is the *perfectly* right choice.

NOTE THE ADVANTAGES

- **Ideal and safe due to its natural circulation system**
- No water hammer or thermal shocks
- Pressure up to 1,000 lb./p.s.
- Robust. The boiler tubes, down-comers, etc. form a strong, welded cage-like structure
- **Quick steam raising**
- High space utilisation
- Low power costs
- Low draught loss

FULL DETAILS OBTAINABLE FROM Newton Chambers & Co. Ltd., Engineering Division, Thorncliffe, Sheffield.

Newton Chambers

OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

Supercritical-pressure steam turbine for Avon plant

Commercial operation of the third supercritical-pressure generating unit in the U.S. was initiated by the Cleveland Electric Illuminating Company just over a year ago. This addition to the Avon Lake Plant has a maximum rating of 250-MW. It has raised the gross capability of the plant to 670-MW and of the total system to 2,269-MW. Designed for an inlet pressure and temperature of 2,500 lb./sq. in. and 1,100 deg. F., a reheat temperature of 1,050 deg. F. and an exhaust pressure of 1 in. hg., the steam-turbine is a Westinghouse tandem-compound, single-reheat, impulse-reaction, triple-flow exhaust machine. The hydrogen inner-cooled generator is rated 273,640 kVA at 22 kV, 0.85 power factor and 45 lb./sq. in. hydrogen pressure, with an operating capability of 297,419 kVA at 60 lb./sq. in. Elevated steam conditions of this unit necessitated innovations in turbine design, as well as in the design of other associated equipment. The Combustion-Engineering-Sulzer-Monotube, or once-through boiler, having no drum or recirculation system incorporates a by-pass system which provides circulation through the boiler during start-up and permits the establishment of steam pressure and temperature before starting the turbine. It also provides a means of protecting the turbine from high temperature and pressure during normal operation. Most of the innovations in turbine design are concerned with the main-steam inlet-valving and piping and the super-pressure element. The exceptionally high steam pressure and temperature are confined to this element in which the steam is expanded to 2,000 lb./sq. in. and 940 deg. F. while producing 30-MW, or 12 per cent. of the unit's maximum output. The other turbine components are therefore essentially conventional in design. To seal the super-pressure element against high-pressure steam leaking out along the shaft, a new nested-type radial seal design developed by the Siemens Schuckert Company was used. This type of sealing arrangement provides a great number of pressure-breakdown labyrinth seals in a relatively short axial length. The rotating discs and stationary rings of this seal are assembled on the rotor-shaft before the rotor is placed in the turbine casing. A hydraulic control system, new in concept, having a 300 lb./sq. in. main operating oil-pump pressure was used. The unit's high operating steam pressures and numerous hydraulic servometers dictated this high-pressure oil system in order to keep the turbine-valve servo-motors of reasonable size and the oil system capacity within that of existing systems. (*Power Engineering*, Vol. 65, No. 1, April, 1961, p. 45.)

Expansion at Oak Creek

Adding 275-MW to the 500-MW generating capacity of the Oak Creek Power Plant's first four units, the station's unit No. 5, initially fired in December, 1959, is the most recently completed unit in this large electricity generating station, operated by Wisconsin Electric Power Company, and situated a few miles south of Milwaukee on the shore of Lake Michegan. Unit No. 1, rated at 120-MW, was placed "on the line" in 1953. Unit No. 2, also of 120-MW rating, was completed in the latter part of 1954, with unit No. 3, rated at 130-MW, entering service in December, 1955. Unit No. 4, a duplicate unit No. 3, began operation during October, 1957. Unit No. 5 is scheduled to be joined later this year by a duplicate unit, No. 6, at present being erected. The station has been designed to ultimately incorporate an eight-unit generating capability of 1,600-MW, to meet the rapidly growing electrical demand in its service area. Coal is delivered to the station by self-unloading lake steamers, which can discharge 2,000 tons per hour. Water for plant operation, amounting to more than 600 million gallons daily, is pumped into the plant and returned to the lake by four 700 h.p. pumps, each of 110,000 gal./min. capacity. Steam for driving unit No. 5 cross-compound 275-MW turbine-generator set is supplied by a Foster Wheeler reheat-type steam-generating unit, while a duplicate of this unit is being supplied by Foster Wheeler for the station's unit No. 6. The boiler has a rated capacity of 1,780,000 lb./hr. of steam with steam conditions at the superheater outlet of 2,425 lb./sq. in. and 1,050 deg. F. from feedwater at a temperature of 488 deg. F. Designed for natural circulation, the major components supplied by Foster Wheeler include: combination radiant and convection superheaters; radiant reheater; economiser; water and steam-cooled furnace; three regenerative air heaters; pulverised coal bin system with 16 intervane burners, and two D-8-D ball-mill pulverisers. The unit is fired vertically downward through the front wall burner-arch using Midwest bituminous coal. (*Heat Engineering*, Vol. XXXVI, No. 1, Jan-Feb., 1961, p. 2.)

Humboldt Bay nuclear power station

Work on the construction of the Pacific Gas & Electric Company's Humboldt Bay nuclear power station commenced on January 23rd, 1961, and ground-breaking for the plant, located near Eureka, California, started in mid-November, 1960. This station will be California's first full-scale atomic electricity generating plant and goes into operation in the summer of 1962. This installation is of particular interest for several reasons; the nuclear unit constitutes the third unit in a plant that has had two oil-fired units in operation for a number of years. The two oil-fired units now in operation have a capacity of 100-MW. It will be the first water-cooled and moderated reactor to use the pressure-suppression method of containment. It has been designed to produce electricity with nuclear fuel at costs that will eventually be competitive with oil-fuel at that location. Bechtel Corporation of San Francisco is engineer and prime contractor for the plant, with the General Electric Company supplying the nuclear steam-supply system, turbine-generator, and other related electric equipment. The nuclear unit features an advanced design,

single-cycle, boiling-water reactor rated at 165-MW thermal, with an initial net electrical output of 50-MW, and will be the largest single-cycle natural-circulation reactor system yet built. In addition to its simplified natural-circulation reactor system, the Humboldt Bay atomic plant will incorporate two technically advanced features—the pressure-suppression reactor containment already mentioned, and internal steam-separation. Both of these features contribute to compactness of plant design and reduced capital and maintenance expenses. These features, together with improved nuclear-fuels now under development, are expected to make the Humboldt Bay unit America's first economically-competitive nuclear electric plant by 1965-1966. The Humboldt Bay nuclear plant will be California's third nuclear generating plant to be placed in operation, and the second joint effort by P. G. & E. and General Electric. The Vallecitos Atomic Power Plant, located near Pleasanton in Almeda County, was the first co-operative venture of the two companies. California's other operating nuclear power plant is the Atomic Energy Commission's Santa Susanna plant, north of Los Angeles, which was commissioned in 1957. (*Power Engineering*, Vol. 65, No. 4, April, 1961, p. 41.)

A further stage in the progress of the construction of Japan's first nuclear power station was marked when, on April 7th, the site offices of the **British General Electric Co. of Japan Ltd.** at Tokai-Mura were officially opened. The ceremony was performed by His Excellency, the British Ambassador, Sir Oscar Morland. About 200 guests were present at the ceremony, including senior representatives of the Japan Atomic Power Company, the First Atomic Power Industrial Group, the British Chamber of Commerce, and Central and Ibaraki Prefectural Government officials.

* * *

Worthington-Simpson Limited have now applied their successful range of type "D" pumps to sump duties covering capacities up to 330 g.p.m. and heads up to 210 ft. depending on capacity. The newly-developed units, which are intended for use in sumps up to 10 ft. deep, comprise a motor, of up to 10 h.p., mounted on a stool holding the main thrust bearing, a sole plate, suspension pipe, shafting, and a pump end from the existing "D" ranges. A feature in design is the fixture of the delivery pipe through the sole plate. This facilitates installations, prevents strain on pump delivery, and presents a neat arrangement. The pumps will handle a wide variety of acids, alkalies and slurries. Certain pumps are also designed to deal with liquids containing solids up to ½ in. dia., and viscous as well as clear liquids.

* * *

It is with regret that we record the death recently of **Mr. J. Dawes,** manager of the Power Road, Chiswick, cubicle manufacturing factory of **Evershed & Vignoles Limited.** Mr. Dawes, who was 77, joined the company in 1948 and had been working until March of this year.

* * *

A Johannesburg firm, **Watermasters (Pty.) Limited,** is to produce and market in South Africa, plant designed by **William Boby and Company,** Rickmansworth, Herts. The agreement between the two companies applies to the whole range of Boby water-treatment equipment. The managing director of the company, **Mr. Michael Boby,** says: "An agreement of this kind is, from our point of view, a far more practical arrangement than an export sales service. It means that we provide the 'know-how,' and Watermasters their production facilities and wide knowledge of local conditions." A South African engineer has been sent to Rickmansworth to study Boby methods and techniques.

At a reception held for representatives of the technical press by **Darlington Chemicals Limited,** at the recent Engineering, Marine, Welding and Nuclear Energy Exhibition, at Olympia, **Mr. D. J. Grant,** managing director of the company announced that the plant at Darlington of the Chemical and Insulating Company (a member of the Darlington group of companies) is at present heavily engaged in producing 85 per cent. Super Magnesia heat insulation material for the geothermal project which is designed to use the water output from the hot springs at Wairakei, North Island, New Zealand, in connection with electrical power generation. The main contract, the total value of which is approximately £900,000, has been awarded to **Aiton & Company,** Derby, and includes the supply and installation of three 30-in. dia. transmission pipelines each two miles long, to carry the steam from the bore hole area to the generating station. Also included in the contract is the heat insulation of the piping. Aiton's have placed the order for the heat insulation material with the Chemical and Insulating Company, who are also supplying the insulation material for the generating station plant.

* * *

W. H. Allen Sons & Co. Ltd., Bedford, have received an order from The Lummus Company, covering the supply of a 750-kW diesel-alternator set for a synthetic rubber plant, being built for synthetics and chemicals at Bareilly, India, the complete installation of which is being handled by The Lummus Company. The unit consists of a 12-cylinder (vee-form) pressure-charged Allen type VBS12C engine, running at 750 r.p.m., and driving a 750-kW Allen alternator suitable for operation on a 3,300-volt, three-phase, 50-cycle supply, at 0.8 power factor. The set is to be supplied complete with radiator, air-compressors and a control panel for alternator and exciter and will incorporate auto-starting equipment for the diesel engine; with the exception of the panel all equipment will be mounted on a skid-type baseplate. Two 3,000-kW steam turbo-alternator sets are also to be installed in this factory and the diesel set will initially supply power for the starting up of the turbo-alternators from then on serving for standby duty.

* * *

Bailey Meters & Controls Limited announce the appointment of **Mr. R. Pearson** as their sales engineer for Scotland, Northumberland and part of County Durham, as far south as a line east to west through the City of Durham.

The General Electric Co. Ltd. recently received a repeat order valued at £139,000, for the supply and installation of a second 100,000 cu. ft./min. turbo-blower at the Cleveland Works of Dorman Long (Steel) Limited. This, and the other machine which is already under construction at the Fraser and Chalmers Engineering Works of G.E.C., will be placed alongside two existing 90,000 cu. ft./min. blowers which were also supplied by the company. The blower, which is to supply air to blast-furnaces, will be of the centrifugal type, having three impellers each of 66 in. dia. running at speeds up to 3,200 r.p.m. The drive will be provided by a steam turbine, direct-coupled to the blower, operating on steam conditions of 425 lb./sq. in. at 725 deg. F. Condensing plant will be supplied by **Mirrlees Watson Limited,** Glasgow.

* * *

A delegation of three engineers from the State Scientific & Technical Committee of the U.S.S.R. Council of Ministers visited the Hartlepool Works of the **Richardsons Westgarth Group** recently. This visit was arranged as a return to one paid to Moscow by a member of the Richardsons Westgarth Group last December. A further visit by Russian engineers and foreign trade representatives to the Richardsons Westgarth Group is being arranged to take place later in the year.

* * *

The Heavy Plant Division of **Associated Electrical Industries Limited** has received an order from **Drysdale & Co. Ltd.** for the main circulating-water pump motors for Drakelow "C" Power Station. This equipment is associated with the 375-MW supercritical turbo-alternator already ordered from the A.E.I. Turbine Generator Division. Six 3,500-h.p., 333-r.p.m., 11,000-V, unity power factor, salient-pole synchronous motors are required to drive the Drysdale pumps, which together, are capable of delivering 40 million gal./hr. of water to the condenser cooling system. The choice of salient-pole synchronous motors by the C.E.G.B. represents a significant change from established power station practice of using induction motors, and recognises the advantages of synchronous machines for large power driving units. These advantages include the economic use of direct-drive to the pumps without the use of reduction gearing; superior efficiency; and minimum kVA input to machines operating at unity power factor. The motors—three of which will be completed in 1962 and three in 1964—will be manufactured at Rugby.

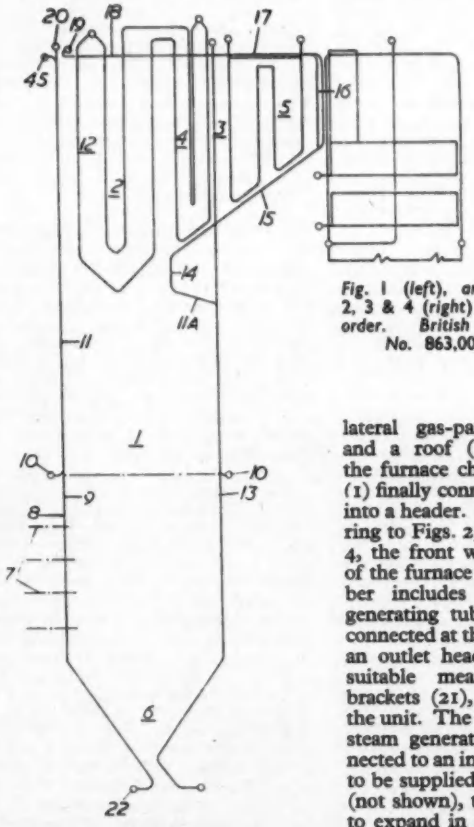
G

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Steam generator

This invention relates to a forced-flow boiler, and the design of furnace tube walls. The once through forced flow steam generator shown in Fig. 1 includes a vertically elongated furnace chamber (1) in communication with an upper region (2) and a gas-pass (3) containing convection superheating and reheating surfaces (4 and 5). The boiler is top-supported by means of a suitable structural steel work (not shown). The furnace chamber (1) is provided with a hopper bottom (6), and is fired by burners, the centre-lines of which are indicated, situated in a front wall (8). The furnace chamber is lined with steam-generating tubes (9) together with, above the level of superheater outlet headers (10) superheating tubes (11). Further superheating surfaces (12) are provided in the upper region (2) of the furnace chamber. Superheater tubes (11A), included in the rear wall (13) are bent inwardly and upwardly to form an arch (14) at the upper region (2) of the furnace chamber (1). The superheater tubes (11A) are further bent to form a floor (15), an outlet screen (16) and roof (17) of the lateral gas-pass (3) and a roof (18) of the furnace chamber (1) finally connecting into a header. Referring to Figs. 2, 3 and 4, the front wall (8) of the furnace chamber includes steam generating tubes (9) connected at their upper outlet ends to an outlet header (20) suspended by suitable means, including header brackets (21), from the steelwork of the unit. The lower outlet-ends of the steam generating tubes (9) are connected to an inlet header (22) arranged to be supplied by a forced-flow pump (not shown), the tubes (9) being able to expand in a downwards direction. The steam generating tubes (9) are arranged in pairs, having adjacent limbs extending downwardly from the header (20) over the height of the furnace chamber, and the limbs (9A) of each pair are disposed at opposite sides of, and are welded to, a bar-like member (23). The laterally-spaced members (23) are united by welds (25) to casing plates (24) so that the tube lengths or limbs (9A) are casing united. The casing is in part supported from the header (20) by the tube limbs (9A), but additional supporting means in the form of sling rods (28) are provided between brackets (29) on uppermost casing plates (27) and header brackets (21). In operation, the bar-like members (23) serve as heat-conducting paths helping to maintain the casing adequately heated. They also help to stiffen the casing. At the outer side of the casing plates (24) is provided suitable insulation (30) mechanically-protected by a light outer metal skin (31). The casing plates (24) and the insulating material (30) are provided with vertically-elongated apertures (32) for the penetration of the top-supported superheating tubes (11) to connect with the superheater outlet header (10) located adjacent to, but outside the casing plates (24), the header (10) being enclosed in a suitable gas-tight chamber (33) associated with the wall (8). *British Patent No.* 863,003 *issued to Babcock & Wilcox Limited. Complete specification published March 15th,* 1961.



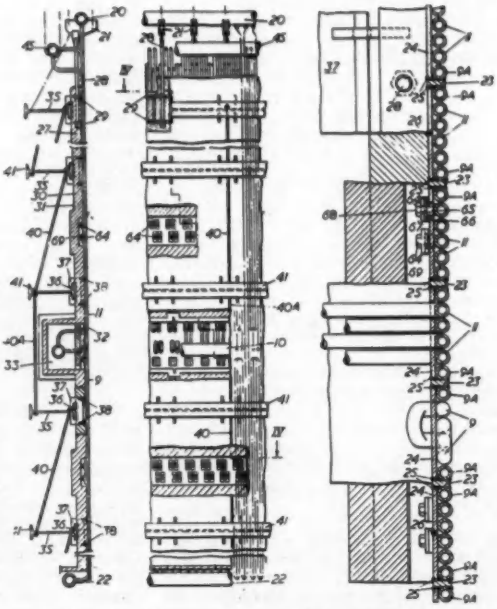


Fig. 1 (left), and Figs. 2, 3 & 4 (right) in that order. British Patent No. 863,003.

Limiting Loss in Transit

This is the job the Caposite and Rocksil insulation is doing on the steam main between SPONDON H Power Station and the British Celanese Works.
Over 2,000 feet of 30" main steam main will carry up to 500,000 lbs. of steam an hour. Keeping the heat loss at a minimum from this and from the subsidiary mains is the job done—and done well by the insulation contractors Thomas Cotton Ltd.—using

CAPOSITE

THERMAL INSULATION MATERIALS

ROCKSIL

Cape Insulation

& ASBESTOS PRODUCTS LIMITED

114 & 116, Park Street, London, W.1. Telephone: Grosvenor 6022

TA 1340

Apparatus for measuring a property of gas-borne dust or of a gas stream carrying dust

The object of this invention is to evolve apparatus for measuring a quantity of gas-borne dust, or of a gas-stream carrying dust. The apparatus is particularly applicable to the measurement of the deposition of dust. It is often desirable to keep a check on the dust carried in the flues of power station boilers or other large emitters of flue-gas. In the apparatus is provided means for selectively collecting dust from the stream in a manner according to the proportions of the coarser particles required. This means comprises a collecting structure which is completely closed, except for an opening facing downwards of the gas stream, so that particles are carried into the structure by their momentum, and not by the gas-stream. In one arrangement, the apparatus comprises an upright tube with a collecting-plate at the bottom of the tube. At its lower end, the tube has an inlet facing towards a gas stream carrying the dust. The tube is closed except for this inlet, so that the particles are carried into the tube by their momentum and settle subsequently on the plate. The apparatus may be used in conjunction with an optical measuring system for measuring the deposition of dust, and the invention includes a transparent collecting-plate arranged at the above mentioned tube. There are a light source and photo-electric means for measuring the charge during a predetermined time in light from the light source passing through the transparent plate on which the dust is allowed to settle. The photo-electric means may comprise photo-cell means for comparing the intensities of light beams received directly, and received through the transparent plate, and an optical wedge for adjusting the intensity of one of the beams to bring the intensities to equality. Fig. 5 illustrates in outline a vertical duct (10) which is closed at its top-and-bottom-ends by transparent glass plates (11 and 12). Leading into the vertical duct (10) is a small horizontal duct (14) which has its open-end facing into the gas-stream. The flue-gas does not enter the vertical duct since there is no exit therefrom, but is deflected around it carrying the very fine dust with it. The coarser particles of dust, which are the particles contributing primarily to the nuisance caused by the flue-dust, and the quantity of which is to be measured, are carried by inertia into the duct (14) and settle in an uneven manner on the lower plate (12). The duct (10) is made sufficiently long compared with its width so that no turbulent gas movements are transmitted as far as the glass plates (11 and 12). The deposition of dust on the plate (12) is measured by an optical measuring system which includes lenses (15 and 16) and prisms (17 and 18), by means of which light from an electric lamp bulb (19) is transmitted through the transparent plates (12, 11 and the duct 10) from the lamp (19) to a photo-transistor-type photo-cell (20). The arrangement outlined in Fig. 5 provides a light-transmitting path through a transparent dust settlement plate in which the dust is allowed to settle on a horizontal surface. It will be readily apparent that many different constructions of settlement regions are possible and, dependent upon their construction, more attention can be paid to heavier particles or to the lighter particles as desired. Adjacent to the photo-cell (20) is an optical wedge (21) which can rotate in order to vary the optical density of the portion of the wedge in the light path. The wedge has a logarithmic light transmission characteristic so as to give a linear variation of optical density with angular movement of the wedge. This wedge is driven by an electric motor (22). Also shown in Fig. 5 is a second photo-transistor type photo-cell (23) which is similar to the photo-cell (20) and is arranged to receive light directly from the lamp (19). A nozzle (24) is provided in the duct (10) into which nozzle compressed-air is fed periodically to provide an air-blast for cleaning the surface of the plate (12). By the use of the optical wedge and standardisation procedure, variations in the photo-cell output due to changes in supply voltage, ageing of the lamp bulb or photo-cell, dirt in the optical system, or changes in the photo-cell temperature will affect the standardisation measurement made before the dust settles as much as the final measurement after the dust settles, and the indication on the chart is affected only by the change which takes place in the measurement in time. Normally, the only change which occurs is the settlement of dust. It is true that if supply voltage or any of the other factors change during the measurement time, an error will be produced. However, it is apparent that the changes which occur in the space of a few minutes will be infinitesimal compared with those which occur in months of service. Furthermore, all these variations are compensated for by movements of the optical wedge, and if they are large, a considerable part of the wedge must be allocated to cope with them, and this restricts the amount of wedge which can be used for true measurement. *British Patent No. 864,072 issued to Central Electricity Generating Board, P. A. E. Crosse, W. L. Snowsill and D. H. Lucas. Complete specification published March 29th, 1961.*

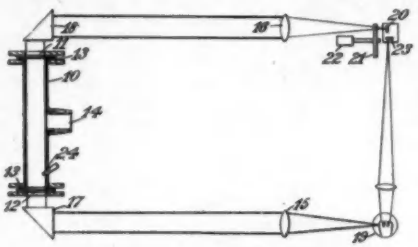


Fig. 5. British Patent No. 864,072.

Generation of steam from waste heat from Siemens-Martin open-hearth furnace

This invention refers to an installation for utilising the waste-heat from Siemens-Martin open hearth furnaces for generating steam. With furnaces of this type, there is, on the one hand, the need to cool the charge-door frames and other constructional elements of the furnace, and on the other hand, it is desired to utilise the heat contained in the waste-gases leaving the furnace. In modern plants the heat derived from the waste-gases and from cooling the constructional elements of the furnace is used for the purpose of steam generation. Water at saturated-steam temperature is circulated through the furnace elements, and waste-heat steam generated by the absorption of waste-heat. It is, however, possible that in tilting furnaces the heat absorption by the cooled door frames

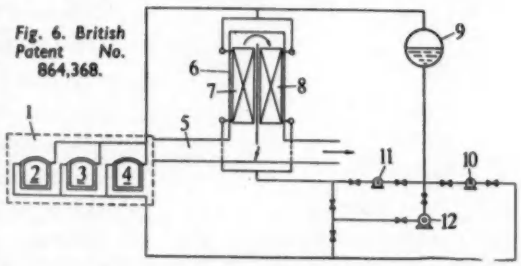


Fig. 6. British Patent No. 864,368.

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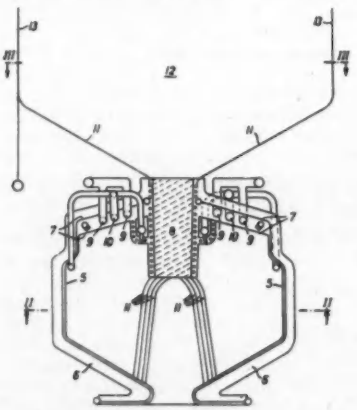
may become particularly high after the slag has been dumped, whereas at this point in time there is hardly any heating of the furnace, and the amount of heat transferred to the waste-heat steam-generator is very small. When the cooling-water is circulated by a pump common to both the furnace elements and the waste heat steam generator, it may be that the cooling-water flows mainly to the waste-heat steam-generator and does not leave sufficient water in circulation to cool the furnace elements. The object of this invention is to eliminate these disadvantages by arranging separate circulating systems for the furnace elements and the waste-heat steam-generator. Two circulating-pumps are, therefore, provided to circulate water at the saturated steam temperature corresponding to the steam generator operating pressure, one pump supplying water to the door frames and other constructional members of the furnace, and the other pump supplying water to the heating surfaces of a waste-heat steam-generator heated by the waste-gases discharged from the furnace.

The Siemens-Martin open-hearth furnace (1) shown in Fig. 6 has charge openings (2, 3 and 4) which are surrounded by door frames cooled by water from a steam generator. To utilise the heat contained in the gases leaving the furnace, a waste-heat steam-generator (6) with heating



surfaces (7 and 8) is connected with the furnace (1) by a conduit (5). The heating surfaces of the water-heat steam-generator and the cooled constructional elements of the furnace receive their cooling medium (such as water) from a common water and steam separation drum (9). A circulating-pump (10) is provided for supplying the water to the cooled elements of the furnace, and the steam and water mixture generated by absorbing heat from the furnace is returned to the drum (9). A circulating-pump (11) supplies cooling medium to the steam-generator heating surfaces in a similar manner. In this way, it is possible to adjust the working conditions in the cooled parts of the plant at all times. One common standby pump (12) is provided for the two main circulating-pumps (10 and 11), and in the event of failure of one of the main circulating-pumps (10 and 11), takes over the duty of that pump. Pump (12) can be of sufficient capacity to take over the duty of both pumps (10 and 11) in the event of failure of both pumps. *British Patent No.* 864,368 *issued to H. Vorkauf. Complete specification published April 6th,* 1961.

Whirling combustion chamber

This invention relates to a water-cooled whirling-combustion chamber with axial discharge of flue-gases from the top of the chamber and with discharge of the slag in molten form through an opening in the bottom of the chamber. It is, of course, already known, that an off-take duct for the gaseous products may be constructed of tubes cooled by boiler feedwater in natural circulation. To this end, in one known arrangement, the tubes are carried upwards through the floor of the combustion chamber, with their lower portions spaced sufficiently far apart to permit the combustion gases to circulate freely

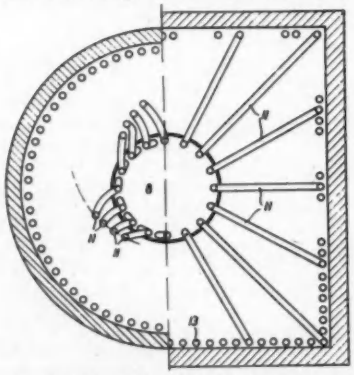


Fig. 7 (left) and Figs. 8 & 9 (above). British Patent No. 865,045.

between them and then to flow upwards through the central off-take duct, the wall of which is formed by the tubes. Hitherto, the tubes had to be forked into branches to form a closed wall for the off-take duct of the flue-gases. However, the forking of such tubes is somewhat expensive and, at the high operating temperatures, they are difficult to keep tight. They also introduce an element of uncertainty with respect to the circulation of the water in the tubes. The combustion chamber of the furnace outlined in Fig. 7 comprises an inner tube lining (5) forming at the lower end, a hopper (6), a roof or cover lining (7), and a central flue pipe or off-take duct (8). The burners and secondary-air nozzles (9 and 10) enter through the roof lining (7). The rising tubes (11) in their lower part are arranged in such a manner that the points of intersection of the axes with a horizontal plane comprise points on a curved line such as a logarithmic spiral, whereas in the upper part the tubes are coiled in parallel helices and contact one another to form the wall of the off-take duct for the gaseous products of combustion. Above the combustion chamber, the tubes (11) diverge in such a manner as to allow them to be embedded in the lining (13) of the enlarged radiation chamber (12). Figs. 8 and 9 showing cross sections on the lines (II-II and III-III) indicate the position of the tubes (11) and their incorporation in the wall lining, and in the central flue pipe (8), the same reference numerals being used for corresponding parts of Fig. 7. *British Patent No.* 865,045 *issued to Walther & Cie, A.G. Complete specification published April 12th,* 1961.

Pulverised-fuel-fired steam generator

The steam-generator shown in diagrammatic outline in Fig. 10 is provided with a combustion chamber (1) and a radiation chamber (2). The radiation chamber (2) is connected centrally at its lower-end to the combustion chamber, to provide a furnace gas outlet channel (3). The combustion chamber, the furnace gas outlet channel (3) and the radiation chamber (2) are of non-circular horizontal cross-section approximating to elliptical cross-section. The combustion-chamber is lined all round with evaporator tubes (4) which are connected to lower boiler headers (5). The furnace gas outlet channel (3) is formed by evaporator tubes (6) which lead from the lower boiler headers (7). Immediately above the combustion chamber, each single cooling tube (4) is branched to a separate cooling-tube (6). Cooling-tubes (8) serve as a lining for the radiation chamber. Cooling tubes (4) of the combustion chamber casing open into the upper boiler headers (9) which are connected by return pipes (10) to the lower boiler headers (9) which are connected by return-pipes (10) to the lower boiler headers (7) and by cooling tubes (11) to the headers (12). Issuing from the headers (12), a number of tubes (11) form a partition (13) at an inter-

mediate position in the length of the radiation chamber. The headers (5 and 7) have water passed to them through fall pipes (14) from the boiler drum (15). The cooling-tubes (8) of the radiation chamber (2) as well as the cooling tubes (11) forming the horizontal wall of the partition (13) open into the steam space of the boiler drum, The preheated water flows to the boiler drum through tubes (16) which, at the same time, serve as supports for the fire-proof lining of the boiler roof. Water flows from a feedwater preheater (not shown). In the upper portion of the radiation chamber are disposed the tubular platens of a superheater space (17). A horizontal connecting pass (18), in which the tubular coil of a contact superheater (19) is mounted, passes the furnace gases to the conventional heating surfaces connected to the outlet side, and disposed in further boiler passes (not shown). From the boiler drum (15), the saturated steam passes through connecting tubes (20) and reaches the contact superheater (19), the tubular coils of which open into the exit collector (21). From the collector (21) the previously superheated steam flows, if need be, after temperature regulation, through connecting tubes (22) to the platens of the superheater space (17) from which it flows through the main steam pipe (23) which is provided with a control valve (24). All the passes of the boiler are surrounded, in the normal manner, by a layer of fire-clay (25) and an insulating layer (26), the outer limit of which is formed by a casing of sheet-metal or suchlike. The fuel is blown into the combustion chamber through nozzles (27), and the combustion air is blown in through nozzles (28). Additional combustion air is passed into the combustion chamber through nozzles (29) which are disposed between the nozzles (27 and 28). The mixture of fuel and air from the nozzles (27 and 28) first flows linearly and parallel to the major axis of the chamber. The furnace gases are then orientated in the narrow portion of the cross-section. The centrifugal forces thus created, whirl the slag particles against the containing walls of the combustion chamber, over which they run down and leave the combustion chamber through a slag outlet aperture (30). The rate of separation of the particles from the gases may be increased by incorporating in the nozzles (27, 28 or 29) or at any other appropriate position, sound reproducers by means of which the furnace gases may be resonated to produce more extensive coagulation of the particles. In order to reduce the heat absorbed by the cooling tubes in the combustion chamber, these tubes are covered with a heat insulating layer. The furnace gases freed from liquid slag flow out from the combustion-chamber, transmit their heat to the heating surfaces, and are then exhausted into the atmosphere by an induced-draught plant (not shown in the diagram). *British Patent No.* 865,112 *issued to Kohlenscheidungs-Gesellschaft m.b.H. Complete specification published April* 12*th*, 1961.

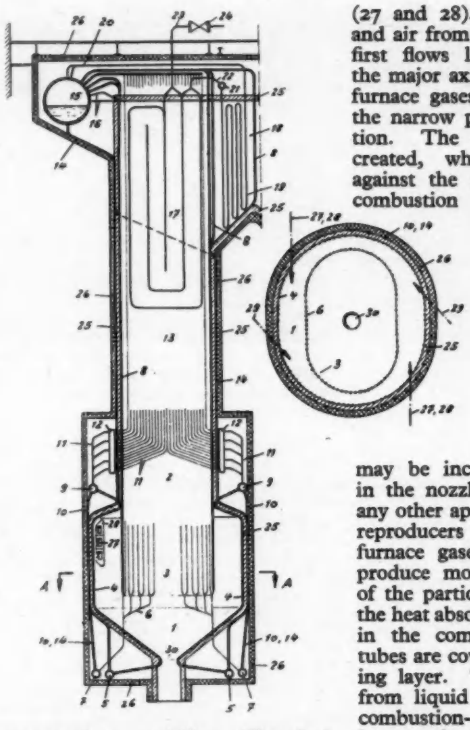


Fig. 10. *British Patent No.* 865,112.

The **Central Electricity Generating Board** have, for some considerable time, installed smoke density indicating and alarm equipment to help combat the emission of dark smoke, which is, of course, an offence under the Clean Air Act. In common with many industrial users, however, the Board experienced some trouble with the sooting-up of the optical systems of the light beam projectors and photocell receivers, particularly when mounted where a positive pressure existed in the flue or the chimney. As a result of this experience, the Board designed their own form of optical system and carried out long-term tests at a number of their power stations. In some of the tests, the interval between cleaning requirements was increased to six months, whilst in some cases up to 18 months have elapsed without the optics being fouled by dirt sufficiently to effect the operation of the equipment. There is no doubt that these tests have been carried out in conditions considerably worse than are likely to be found on a normal industrial installation, and, therefore, in practice, these figures can possibly be improved upon. Having produced this highly-efficient piece of equipment, the C.E.G.B. has applied for a patent (No. 5654/59), and has granted **Photoelectronics (M.O.M.) Ltd.,** licence to manufacture the equipment in conjunction with their well-known smoke alarm type-CCSA and smoke density indicator type-CCSI. This combination of Photoelectronic equipment and the C.E.G.B. "Everclean" windows, is claimed to provide an installation requiring considerably reduced maintenance, and with full alarm, indication and recording facilities suitable for the smallest to the largest installation.

* * *

Mr. W. N. C. Clinch, O.B.E., M.I.E.E., controller of the Eastern Division of the Central Electricity Generating Board, recently retired from that position. Mr. Clinch, a very well-known personality in the industry, served for some years with the former Northmet Power Company before his appointment in 1930 as borough electrical engineer of Brighton. He returned to the Northmet Company in 1943 as assistant general manager, and later in that year succeeded Capt. J. M. Donaldson as general manager. He was appointed controller of the Eastern Division when the electricity supply industry was nationalised.

Simon-Carves Limited have been awarded a contract by the Eastern Gas Board, for the supply and erection of an Otto Continuous Reforming Plant at Dunstable Works, to produce five million cubic feet per day of enriched town's gas from liquefied petroleum gases. The order includes the supply of shift conversion plant for the detoxification of the gas, and for feedstock storage, etc.

* * *

A recently-issued eight-page publication (List 25/1) describes the vapour pressure thermometers manufactured by the **Cambridge Instrument Co. Ltd.** Details of standard instruments are provided, and information is also given on a wide variety of modifications and accessories which may be supplied to suit individual applications and processes. Cambridge V.P. Thermometers are made with either 6 in. or 4 in. dials calibrated to cover a variety of ranges within the limits — 20 deg. C. to + 340 deg. C. (— 10 deg. F. to + 650 deg. F.). They have a sensitivity equal to that of high-grade mercury-in-glass thermometers, and the makers guarantee an accuracy of within 1 per cent. of their range. Electrical contacts for alarm or control purposes may be fitted.

NOTES Personal AND Industrial

The Rt. Hon. Lord Clitheroe has been appointed a vice-chairman of Tube Investments Limited. **Sir Ben Lockspeiser,** having reached retirement age, and **Sir Francis de Guingand** have retired from the board. **Dr. J. M. Kay,** at present Professor of Nuclear Power at the Imperial College of Science and Technology in the University of London, has been appointed to the board of Tube Investments Limited, as director of Research and Development, as from July 1st.

* * *

Mr. Norman Elce, M.Sc.Tech., M.I.Mech.E., F.R.S.A., director and chief mechanical engineer, Associated Electrical Industries (Manchester) Limited, has retired after 41 years with the A.E.I. group of companies. He has been appointed consultant to the managing director at Manchester.

* * *

The Central Electricity Generating Board (Midlands and East Midlands Region) announces that the following appointments have been made in the newly created regional electrical department which will be responsible for all transmission construction work in the Region as well as the co-ordination of commissioning tests on protective gear, metering, communication equipment and system development. **Mr. W. W. Smith,** M.I.E.E., has been appointed regional electrical engineer; **Mr. J. D. Pierce,** M.I.E.E., has been appointed regional transmission project engineer; **Dr. L. B. Wood,** A.M.I.E.E., has been appointed regional technical and development engineer.

* * *

Mr. R. T. Pemberton has been appointed to the board of directors of Stone-Platt Industries Limited.

* * *

Thos. W. Ward Limited has announced the appointment of **Mr. Stanley Jessop** as manager of its works at 18-24, Fore Street, Scotstoun, Glasgow. He will be in charge of the company's engineering interests in Scotland.

* * *

Mr. N. A. C. James, southern England area manager, Cape Insulation and Asbestos Products Limited, has been appointed controller, Government Contracts Division. **Mr. N. H. Wimhurst** becomes the new southern England area manager.

* * *

It is with regret we record the death recently of **Mr. W. A. Shaw,** A.I.E.E., a director of Evershed & Vignoles Limited, after 48 years of service with the company. In April, 1949, he was appointed general sales manager in succession to **Mr. F. C. Knowles,** whose chief assistant he had been for 30 years, and in November, 1953, was elected to the Board of the company as sales director. Recently he was appointed company secretary.

Keith Blackman Limited, manufacturers of the "Tornado" range of fan engineering and industrial gas equipment, announce that **Mr. D. S. Woodley,** M.I.Mech.E., M.I.H.V.E., whilst remaining as chairman and consultant to the company, retired from the office of managing director on May 31st. **Mr. F. W. Goodge,** one of the present joint assistant managing directors, has been appointed by the Board to succeed Mr. Woodley as managing director from June 1st and **Mr. C. J. Atkins** will become assistant managing director from the same date.

* * *

British Hydrocarbon Chemicals Limited announce the appointment of **Mr. J. G. Hill** as works manager at their Baglan Bay factory, with effect from July 1st, 1961. Mr. Hill has been plant manager of Forth Chemicals Limited at Grangemouth since October, 1951, and previously was with Monsanto Chemicals Limited, Ruabon, where he was maintenance manager for some five years.

* * *

Darchem Engineering Limited, a member of the Darlington Chemicals Group, announces that **Mr. A. B. Miles,** has been appointed chief engineer and has been succeeded as chief draughtsman by **Mr. F. Meadows. Mr. D. A. Rowlett** has been appointed manager of the Rostenit (stainless steel lining process) Division.

* * *

The General Electric Co. Ltd. announces that **The Rt. Hon. Sir Toby Low** has been elected vice-chairman of the company. **The Rt. Hon. Lord Coleraine, Mr. M. Sobell** and **Mr. A. Weinstock** have been elected directors.

* * *

Consequent on the appointment of **Dr. R. Spence,** C.B., F.R.S., as deputy director of the Atomic Energy Research Establishment, Harwell, **Dr. W. Wild** has been appointed head of the Chemistry Division. He has responsibility for the scientific work of three branches: Chemical Processing and Reactor Chemistry; Radiation Chemistry and Solid State Chemistry; Radiochemistry. **Mr. A. A. Smales,** O.B.E., head of the Analytical Chemistry Branch, has been given the status of a division head, and will be directly responsible to the director, A.E.R.E., for the scientific work under his control. His branch will continue to use the general administrative services of the Chemistry Division.

* * *

At the last meeting of the Council of the Electrical Research Association, it was agreed that the vice-chairman, **Mr. L. Rotherham,** should be invited to become chairman for 1961/2, and he was duly elected to take office immediately following the annual general meeting on May 3rd, 1961. At the same meeting, **Mr. S. E. Goodall** was elected vice-chairman of the council.

Mr. W. F. Gerrard, F.R.I.C., has resigned from his position as technical manager of The Liverpool Borax Co. Ltd. (Feedwater Specialists Co. Division), and has been appointed managing director of the Atlantic Water Treatment Co. Ltd., 87-89, Victoria Street, Liverpool, 1.

* * *

Mr. R. T. Miller has been appointed managing director and **Mr. A. George** assistant managing director of Fletcher Miller Limited, a member of the Castrol Group of Companies.

* * *

Mr. W. E. Hughes has been appointed director and general manager of British Industrial Gases Limited, Enfield. He succeeds **Mr. F. Blackmore,** who is now manager of Equipment Development, Technical Division, The British Oxygen Co. Ltd.

* * *

The Mitchell Construction Company has been awarded the first civil engineering contract for the construction of the Central Electricity Generating Board's West Burton Power Station in Nottinghamshire. The contract is valued in the region of £1,300,000, and covers all the preliminary civil engineering work; 1,700,000 cu. yd. of excavation, access roads and rail-track, main drainage, flood-protection and other miscellaneous work. The consulting engineers are Messrs. Merz and McLellan.

* * *

A few weeks ago the Mayor of Huddersfield formally opened a new apprentice training school adjoining the works of **Hopkinsons Limited,** the well-known valve manufacturers, where courses in craft, technical, commercial and graduate apprenticeships are available. The school has workshop, lecture room and office accommodation, under the supervision of a full-time training officer, and a practical instructor. The opening ceremony, under the chairmanship of Mr. I. G. Hopkinson (director and works manager) was attended by the leading technical educational and youth employment authorities in the Huddersfield area, and by parents of boys now serving their apprenticeships with the firm.

* * *

Electronic Instruments Limited, Richmond, Surrey, are to produce and market the Hardicon residual water-hardness detector under an agreement with **William Boby and Co. Ltd.,** the well-known water-treatment engineers, who designed the equipment which has already met with considerable success. In addition to their production facilities, Electronic Instruments will be able to offer buyers of the Hardicon a world-wide after sales service. The fully-automatic detector tests the water by means of a photo-electric cell. When hardness is detected, the instrument sounds an alarm or automatically shuts down the plant.